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28th Annual Session
AMERICAN CONGRESS OF PHYSICAL MEDICINE

August 28, 29, 30, 31, September 1, 1950

HOTEL STATLER BOSTON

VOLUME XXXI AUGUST, 1950 NO. 8

American Congress of Physical Medicine

28th Annual

Scientific and Clinical Session

and

Instruction Seminar

August 28, 29, 30, 31, Sept. 1, 1950

Official Headquarters

HOTEL STATLER

Boston, Massachusetts

EXECUTIVE OFFICES

30 NORTH MICHIGAN AVENUE CHICAGO 2, ILLINOIS

INSTRUCTION SEMINAR

In Conjunction with the

28th Annual Scientific and Clinical Session

AMERICAN CONGRESS OF PHYSICAL MEDICINE

August 28, 29, 30 and 31, 1950

HOTEL STATLER — **BOSTON, MASS.**

SCHEDULE

Physicians only may enroll for letter series

MONDAY MORNING — AUGUST 28		
	(A) 10:00-10:50 A.M. Neuro-anatomy of the brain and spinal cord Parlor B Corbin	(B) 11:00-11:50 A.M. Neuro-anatomy of the brain and spinal cord Parlor B Corbin
MONDAY AFTERNOON — AUGUST 28		
	(C) 3:00-3:50 P.M. Pathologic physiology of lesions of the brain (types and localizations producing motor disturbances) Parlor B Karnosh	(D) 4:00-4:50 P.M. Pathologic physiology of lesions of the spinal cord (localization of lesions, including poliomyelitis) Parlor B Karnosh
TUESDAY MORNING — AUGUST 29		
	(E) 8:30-9:20 A.M. Pathologic physiology of peripheral nerve lesions, including the neuritides Parlor B De Lorme	(F) 9:30-10:20 A.M. The physiologic effects of heat Parlor B Bierman
WEDNESDAY MORNING — AUGUST 30		
	(G) 8:30-9:20 A.M. Technic of medical writing Parlor B Hammond	(H) 9:30-10:20 A.M. Technic of medical writing Parlor B Hammond
THURSDAY MORNING — AUGUST 31		
	(J) 8:30-9:20 A.M. Physics of muscular action Parlor B Lion	(K) 9:30-10:20 A.M. Physics of muscular action Parlor B Lion

Physicians and registered physical and occupational therapists may enroll for numbered series

MONDAY MORNING — AUGUST 28		
	(1) 10:00-10:50 A.M. Recent hormonal investigations in rheumatoid arthritis Parlor C Polley	(2) 11:00-11:50 A.M. Recent hormonal investigations in rheumatoid arthritis Parlor C Polley
MONDAY AFTERNOON — AUGUST 28		
	(3) 3:00-3:50 P.M. Physical Medicine in rheumatoid arthritis, in the light of the new treatment Parlor C Clark	(4) 4:00-4:50 P.M. The clinical use and dangers of microwave Parlor C Rae
TUESDAY MORNING — AUGUST 29		
	(5) 8:30-9:20 A.M. Analysis of pathologic gaits, and gait training Parlor C Deaver	(6) 9:30-10:20 A.M. Resistive exercises in treatment of poliomyelitis Parlor C Schram
WEDNESDAY MORNING — AUGUST 30		
	(7) 8:30-9:20 A.M. Useful mechanical devices used in Physical Medicine and Rehabilitation Parlor C Russek	(8) 9:30-10:20 A.M. Exercise in the treatment of asthma Parlor C Baker
THURSDAY MORNING — AUGUST 31		
	(9) 8:30-9:20 A.M. Indications for orthopedic reconstruction in poliomyelitis Parlor C Green	(10) 9:30-10:20 A.M. Disabilities of the shoulder Parlor C Kottke

Note: The Committee on Education of the American Congress of Physical Medicine is in charge of the instruction seminar. It is purposely planned to limit the subjects in any year to a few topics in order to devote enough time to those subjects to give those attending a good review, both from the standpoint of basic knowledge and from the clinical standpoint. Certain groups of these subjects will be repeated every three to five years.

Courses will be offered in two separate groups: One group of ten courses will be offered on basic subjects and this group will be open only to physicians. A second group of ten courses will present more general and clinical subjects. Physicians and therapists may register for the second group of courses. Only those therapists registered with the American Registry of Physical Therapy Technicians or the American Occupational Therapy Association will be permitted to enroll for the instruction courses. The charge for a single lecture is $2.00, for a full schedule of ten lectures, $15.00.

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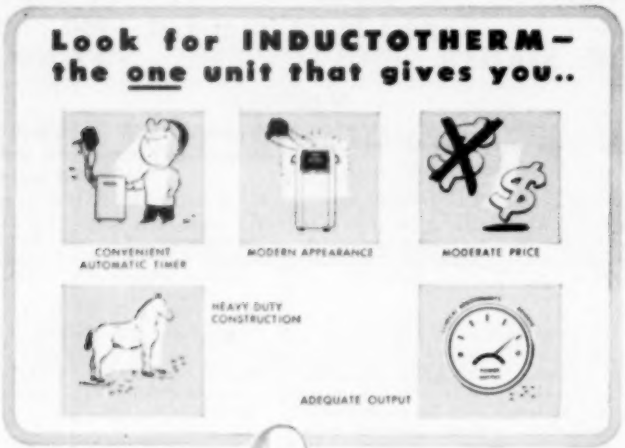

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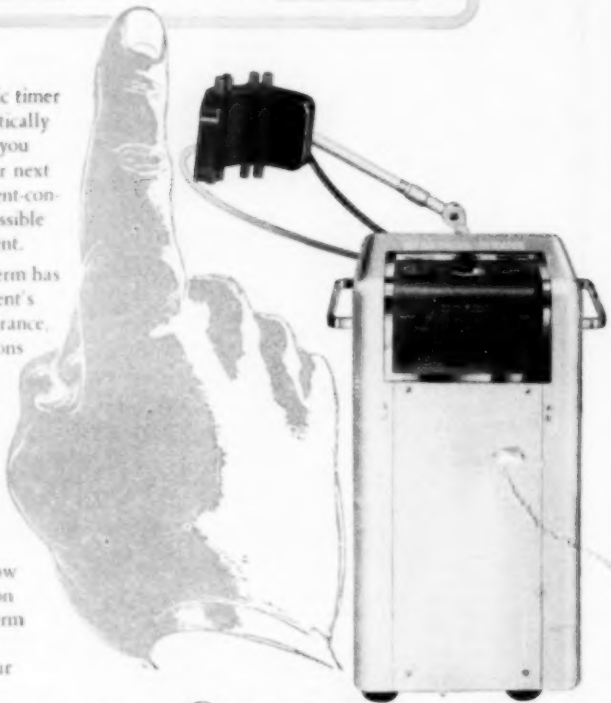

GENERAL ELECTRIC
X-RAY CORPORATION

Contents—Aug. 1950

Volume XXXI No. 8

ARCHIVES OF PHYSICAL MEDICINE
(Formerly Archives of Physical Therapy)

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ORIGINAL ARTICLES

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EDITOR OF THE MONTH

WALTER M. SOLOMON, M.D.
Cleveland, Ohio

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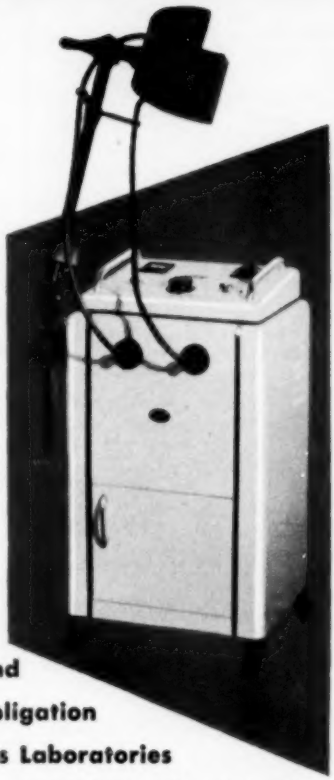

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INFRARED HEATING OF TISSUES *

FRANCIS X. SWEENEY, M.D.
STEVEN M. HORVATH, Ph.D.
H. C. MELLETTE
and
B. K. HUTT

PHILADELPHIA

The particular property that distinguishes infrared radiation is that when absorbed in the tissues it produces no specific reaction, causing nothing but a rise in temperature. Nonetheless there has raged a long controversy regarding the relative ability of various fractions of infrared energy (in terms of near and far infrared) to penetrate tissues. Although it may be true that one or the other may penetrate a fraction of a centimeter deeper within a certain small unit of time, the main fact has been ignored, i. e., that the sum total of the energy being delivered by a source should determine, all other conditions being equal, the final temperature in the part being treated. In current textbooks on physical medicine[1] it is stated that near infrared is more efficient in heating human tissues than is far infrared. These statements were apparently based on reports by Sonne[1b] and Loewy and Dorne.[2] However, Laurens and Foster[1c] showed that "In the infrared bands, the effects are very similar, the temperatures at all depths produced by a given quantity of energy from the hot plate (long infrared) being practically identical with the temperatures produced by the same amount of energy from the electric heater (shorter infrared)." Recently in a preliminary communication[3] the the statement was made that far infrared radiation was more efficient than near infrared radiation. This confusion in delineating the effect of infrared radiation suggested the need for reinvestigation.

Methods

The experiments were performed on 10 healthy males. The subjects were stripped to their shorts and were lying on a bed in an ambient temperature of either 30.5 ± 1.0 C. (warm room) or 20.5 ± 0.5 C. (cool room). After a rest period of approximately thirty minutes, temperature measurements were begun and control readings obtained for the following thirty minutes. An infrared source was then applied to the upper thigh or in several instances to the buttocks. Temperature measurements were continued for an additional sixty minutes in order to secure information on cooling rates.

The electromotive force developed by copper-constantan thermocouples was recorded by means of a modified Brown Recording Potentiometer. Each temperature was recorded once every 110 seconds. Thermocouples were placed on the outer lateral surface of each thigh, on one big toe of each foot, on a middle finger and in the room air. Needle thermocouples were employed to measure muscle (45 min.) and subcutaneous (6 to 10 mm.) temperatures. All couples were protected from the direct rays of the lamps employed as infrared sources. Rectal temperatures were measured by a calibrated clinical thermometer immediately before and after treatment. In a majority of instances they were also obtained at the cessation of the experiment.

In order to determine the total effective energy output of these lamps, as clinically employed, calorimetric studies were made. The calorimeter was a tapered blackened

* From the Department of Physical Medicine, Graduate School of Medicine University of Pennsylvania.
* Aided by a grant from the National Foundation for Infantile Paralysis, Inc.
* Read at the Twenty-Seventh Annual Session of the American Congress of Physical Medicine, Cincinnati, Sept. 8, 1949.

1. (a) Evans, D. S., and Mendelssohn, K.: Brit. M. Bull. 3:143, 1945; Proc. Roy. Soc. Med. 38: 578, 1945. (b) Sonne, D.: Acta med. scandinav. 84:336, 1931. (c) Laurens, H., and Foster, P. C.: Am. J. Physiol. 118:372, 1937.
2. Loewy, A., and Dorne, C.: Strahlentherapie 20:411, 1925.
3. Gersten, J. W.; Wakim, K.; Stow, R., and Porter, A. M.: Federation Proc. 8:56, 1949.

cylinder, having a volume and surface area similar to that of an adult human thigh. Although these studies do not provide an exact estimate of the amount of energy being absorbed by a patient's thigh, they do provide for a comparative evaluation of the total energy which was directed at the patient.

Two sources of near and three of far infrared radiation were employed in these studies. All units were preheated for a period of ten to fifteen minutes prior to use. The lamps have the following characteristics:

Unit 1: Far infrared; employed at distances of 21 inches, zoalite, Burdick Type Z-12, 600 watts.

Unit 2: Near infrared; employed at a distance of 36 inches and in two instances at 40 inches, carbon element, luminous bulb, 375 watts.

Unit 3: Far infrared; employed at a distance of 24 inches, Zoalite, Burdick Type Z-30 carborundum element, 1000 watts.

Unit 4: Far infrared; McCalls Desert Lamp, employed at a distance of either 20 or 36 inches, earthen element, 500 watts.

Unit 5: Near infrared; Burdick Baker type I-S, 8 tungsten filament bulbs, 60 watts each, total 480 watts.

In a number of instances these units were operated at a lower power input. The input voltage was reduced from 110 to 65 volts.

Results

The calorimetric studies were conducted in the same manner as the experiments on the human subjects. Duplication of results was obtained on the first runs on each infrared source. It was observed that if the lamps were employed steadily over considerable periods of time (three to five hours), the energy output as measured, tended to decrease for a few runs and then to be restabilized at a new level. The only exception was observed with unit 5, with which the level progressively increased before stabilization. The energy output of the various units was, in calories per minute, as follows: unit 1, 0.3901; unit 2, 0.3968; unit 3, 0.3629; unit 4, 0.3720, and unit 5, 0.6328. The output of the first four units was almost identical, and rather exact comparison can be made of their ability to raise tissue temperatures. The major difficulty of such comparison lies in determining the extent of spillover, or loss to the subject, of the energy output of these heat sources. In all probability there was an equivalent amount of such loss both in the calorimeter employed and in the thigh of the subject being treated.

Twenty-four of the tests were made in the warm and 10 were made in the cool environment. The changes in rectal temperature were not significant, being ±0.05 degree C. In the majority of the experiments no change was observed. The temperature of the control, opposite, thigh was generally unaltered during the experiment. When changes did occur, they were usually decreases (fig. 3) or very occasionally a slight increase (fig. 1). In two of the four tests where heat was applied to the buttocks, surface temperature rises on the control side were observed, indicating a certain amount of direct spillover. Peripheral vasodilatation in fingers or toes as a consequence of the heating was rarely observed. It occurred twice during tests at 30.5 C. and once at 20.5 C. No lamp produced this effect on more than a single occasion.

The mean changes in the temperature of the surface of the subcutaneous tissues and of the muscle tissues following the application of near and far infrared radiation are presented in tables 1 and 2. Charts 1 to 5 are presented for the purpose of illustrating more completely and adequately the minute to minute changes that occurred. Unit 2 was the most effective in elevating the surface temperature regardless of environmental temperature. The final maximum skin temperature during the heating period was found to be roughly equivalent in the two environments. The remaining infrared sources were roughly comparable in inducing rises in skin temperature. It was somewhat disturbing to observe that unit 5, despite its having the largest

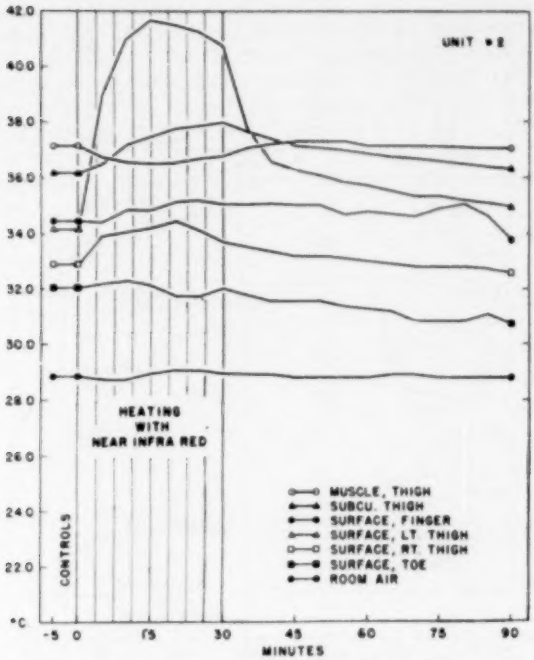

Chart 1. — The temperatures of various areas before, during and after exposure to a source of near infrared radiation. The experiment was conducted in a warm environment. This subject was the only one who showed a drop in muscle temperature during treatment with unit 2.

TABLE 1. — *Mean Changes in Temperature of Tissues as a Consequence of Heating with Various Types of Infrared Sources.*

(Nude Subjects at an Environmental Temperature of 30.5 ± 1.0 C.)

Infrared Heat Source	Subjects, No.	Initial Temp., ° C.	Change in Temperature ° C. — Heating: 15 Min.	Heating: 30 Min.	Cooling: 15 Min.	Cooling: 30 Min.	Cooling: 45 Min.	Cooling: 60 Min.
Skin surface								
Near, unit 2	5	34.38	6.28	5.90	1.72	1.20	0.74	0.20
Near, unit 5	5	34.20	3.50	4.18	1.56	1.16	1.16	1.02
Far, unit 1	5	34.12	3.80	3.86	1.40	0.96	0.62	0.24
Far, unit 3	3	34.40	3.70	4.53	2.07	1.60	1.03	0.50
Far, unit 4	3	33.80	2.96	4.03	1.73	1.20	0.80	0.23
Subcutaneous tissues								
Near, unit 2	5	35.20	4.06	3.55	1.72	1.20	0.80	0.23
Near, unit 5	5	34.32	2.40	3.40	1.28	1.08	1.04	0.76
Far, unit 1	5	34.46	2.66	3.18	1.88	1.30	0.94	0.58
Far, unit 3	3	35.10	2.37	3.17	2.03	1.50	1.10	0.85
Far, unit 4	3	34.60	1.73	2.27	1.43	0.83	0.50	0.13
Muscle tissues								
Near, unit 2	5	36.58	0.36	0.56	0.82	0.60	0.42	0.13
Near, unit 5	5	36.50	0.32	0.78	0.73	0.55	0.43	0.33
Far, unit 1	5	36.60	0.14	0.52	0.56	0.44	0.32	0.18
Far, unit 3	3	36.87	0.00	0.33	0.63	0.60	0.50	0.30
Far, unit 4	3	36.76	0.07	0.33	0.43	0.33	0.17	—0.03

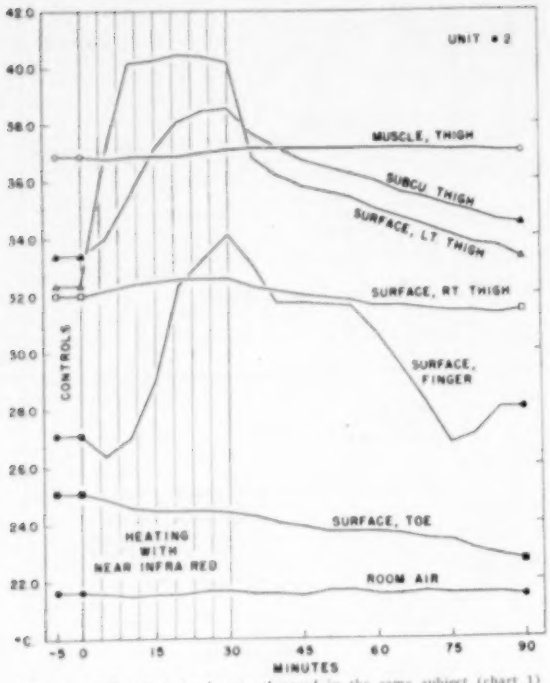

Chart 2. — Temperature changes observed in the same subject (chart 1) exposed to the same source of near infrared radiation but in a cool environment.

source of energy (calorimetric determinations), was not more capable of raising skin temperature. This was probably related to the fact that a larger area of skin was heated.

TABLE 2. — *Mean Changes in Temperature of Tissues as a Consequence of Heating with Various Types of Infrared Sources.*

(Nude Subjects at an Environmental Temperature of 20.5 ± 0.5 C.)

Infrared Heat Source	Subjects, No.	Initial Temp., °C.	Change in Temperature °C. Heating 15 Min.	Heating 30 Min.	Cooling 15 Min.	Cooling 30 Min.	Cooling 45 Min.	Cooling 60 Min.
Skin surface								
Near, unit 2	5	31.56	8.94	8.80	4.06	3.10	2.12	1.58
Near, unit 5	1	31.70	5.80	7.30	3.95	2.60	1.80	1.20
Far, unit 1	2	32.35	6.30	6.85	3.25	2.30	1.50	0.95
Subcutaneous tissues								
Near, unit 2	5	32.50	3.76	5.02	3.68	2.92	2.20	1.56
Near, unit 5	1	33.40	1.40	3.60	2.70	1.60	0.80	0.20
Far, unit 1	2	33.45	3.65	4.80	2.55	1.70	1.15	0.85
Muscle tissues								
Near, unit 2	5	36.38	0.08	0.38	0.64	0.62	0.50	0.38
Near, unit 5	1	36.40	0.00	0.50	0.80	0.60	0.30	0.00
Far, unit 1	2	35.05	0.35	1.70	1.80	1.40	1.05	0.75

The near infrared sources were also the most effective in elevating the temperature of the subcutaneous tissues while heat was being produced. This also applied to the muscle tissues during the first fifteen minutes of the

heating period. At the cessation of the treatment this was still true but not to the same extent. Unit 1, far infrared, was able to raise muscle temperature to nearly the same degree as unit 2. In the experiments conducted in a cool environment the far infrared was more effective in elevating muscle temperature than the near infrared (table 2).

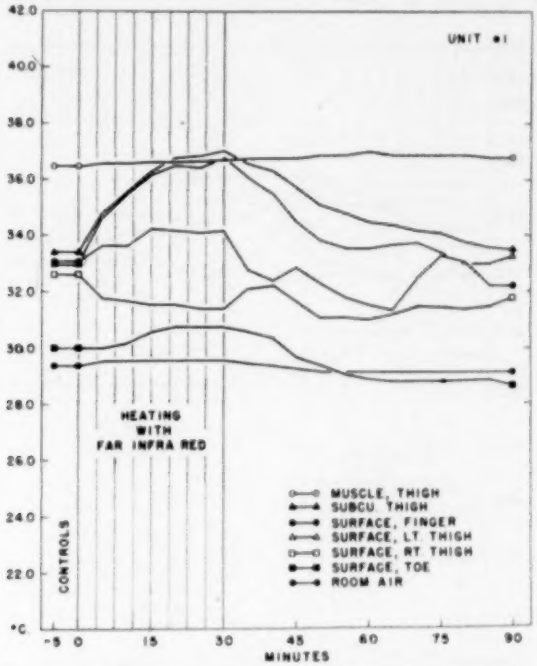

Chart 3. — Temperature changes in different tissues observed while the subject was in a warm environment and exposed to far infrared radiation.

The cooling curves are probably of even greater interest than the heating curves. In only a few instances had the elevated tissue temperatures returned to control levels within one hour following the treatment. The surface and subcutaneous temperatures dropped precipitiously immediately on cessation of heating whereas in most all instances muscle temperatures rose, sometimes to levels double those observed during heating, or else fell very slowly. This was observed in both warm and cool environments.

Comment

It may be trite to repeat that from antiquity it has been known empirically that heat per se would relieve pain and promote recovery from certain disabilities. However, since the advent of Maxwell's electromagnetic theory and the manufacture of heat-producing therapeutic devices classified as delivering near or far infrared radiation, much ambiguity has resulted regarding our knowledge of infrared heat and its effects. Cognizant of this state of affairs, we felt impelled to take the various infrared lamps and heaters used in our department for the treatment of patients and test them under

field conditions, in order to gain some knowledge of their relative heating abilities and efficacy.

The physiologic reactions to local heating are rather complex. It is known that the rapid increase in peripheral circulation of the locally heated area increases the thermal conductivity of the tissues and distributes the heat over a very large area, in fact through the whole body, and thus hinders

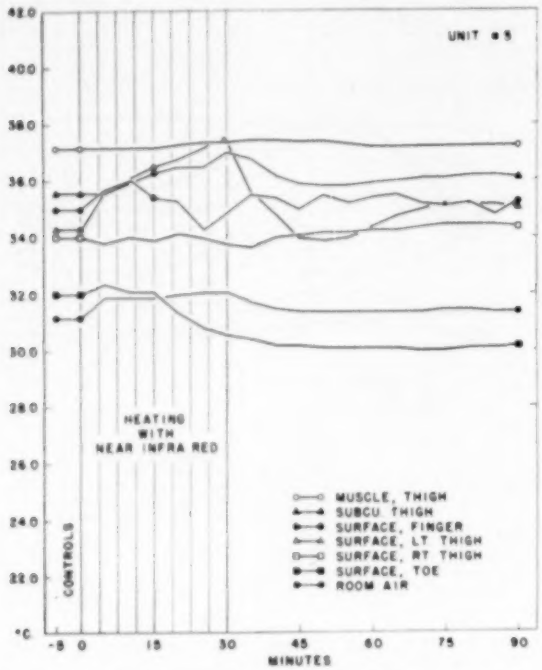

Chart 4. — The temperature of surface areas and of deeper tissues before, during and after exposure to near infrared radiation. The subject was reclining in the warmer environment.

the rise in local temperature. The work of Sir Thomas Lewis and his associates suggests that reflex vasodilatation to warmth at a distance was entirely dependent on the sympathetic nerve supply to the area involved (inhibition of normal tone). However, the occurrence of vascular adjustments in denervated areas has long been recognized. Warming the skin surface to a temperature of 37 C. can occur rapidly, and not only does the venous blood in its return carry heat inward, and the more rapidly the greater the vasodilatation, but also the increased arterial supply warms the tissue at the expense of the rest of the body. Above 37 C. the vascular dilatation acts as a deterrent, constantly bringing in blood at a lower temperature and cooling the local area at the expense of the rest of the body.

The evaluation of the effectiveness of heat sources presented quite a problem. Thermoradiometric readings to determine radiant flux were not employed, for it is known that heat energy from the usual clinical sources is received on the part to be treated in the form of a series of "contour lines"

of varying energy levels.[16] These were demonstrated in a striking manner in our experiments when 3 of the subjects suffered burns illustrating definite "energy profiles." Also, all lamps or heaters used clinically have a "spill-over" due to the fact that, unlike roentgen rays, infrared has no definite beam of radiation to be focused on the part; and at the distances specified for use, some of the radiant energy goes by the part to be treated. Hence it was felt best to measure the total effective energy by use of a dummy having the same configuration as that of a thigh and placed in the same position and

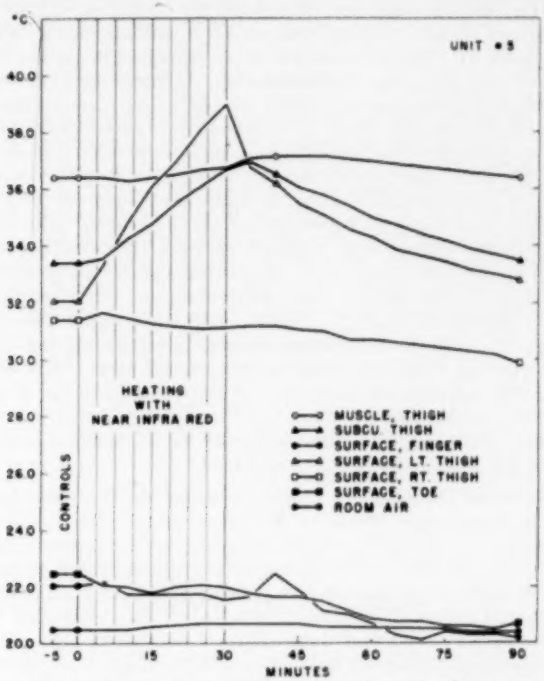

Chart 5. — Similar to chart 4, with the exception that the test was conducted in a cool environment.

treated in the same manner as the human test limbs. Calorimetrically, all the sources, with the exception of the baker, gave total effective energy figures in the range of 0.39 calories a minute.

In several experiments the voltage was reduced to approximately 60 per cent — i. e., from 110 to 65 volts — by means of a powerstat. Calorimetric determinations indicated only 40 per cent total effective energy under these conditions. This finding agreed with the rises in skin and subcutaneous temperatures, which were roughly 40 per cent of the full power studies. The muscle temperatures remained unchanged or fell slightly. Weak sources of infrared irradiation are apparently of little clinical value.

The lamps were employed at distances recommended for most effective clinical use. In the case of unit 2, however, burns were produced in 3 of the 13 experiments that were conducted. The same subjects had been exposed both before and after these incidents without repetition of these injur-

ies. Skin temperatures measured both within the burn area and at distances 5 to 20 millimeters away were in the neighborhood of 42 C. It was somewhat surprising to obtain burns at this temperature. However, subcutaneous temperatures were correspondingly elevated — i. e., 7 degrees C. in these subjects.

Three far and one near infrared sources (units 1, 2, 3 and 4) delivered approximately equivalent total energy as determined calorimetrically. Theoretically they should have produced somewhat equivalent changes in tissue temperatures. Unit 4 (infrared) was definitely the most inferior in this respect. However, it was roughly comparable to the remaining two far infrared lamps (table 1). The greatest and most rapid rise in surface temperature occurred with unit 2, a near infrared device. Interestingly, the temperatures of both skin and subcutaneous tissues tended to decrease during the latter part of the heating period. Even in these circumstances the values for these tissues were still higher than the final values obtained with far infrared. However, with all units the normal tissue temperature gradient was reversed. These results were generally more in agreement with those presented by Bierman[4] than with those presented by Sonne and others.[5] In order to eliminate the profound effects from vascular changes and leave only conduction and absorption of "penetrating rays" as possible complicating agents of penetration to deep layers, similar runs were made in a constant temperature room at 20.5 degrees C. (table 2). Here again the greatest skin temperature rise was produced by the near infrared (unit 2), attaining final values (40.4 C.) similar to those observed in the warmer environment. The subcutaneous and the muscle temperature rises were greatest with the far infrared. The final maximum values reached were, however, somewhat lower in this cooler environment. This suggests that there may be an optimum environmental temperature for administration of treatments.

Near infrared produced its maximum effect on the skin surface. The subcutaneous temperature does not rise immediately after the application of heat (charts 1, 2, 4 and 5) but waits until the surface temperature nears its maximum level. In contrast, far infrared sources appeared to induce elevations in both surface and subcutaneous temperatures at about the same time and early in the course of treatment (chart 3). This difference in response at these two tissue levels was even more noticeable in the cooler environment. It could be construed from these observations that far infrared has slightly greater ability to penetrate the surface and reach the blood supply at the deeper levels. This would agree with Gersten and co-workers.[5]

The importance of blood flow for temperature equalization was apparent from the comparative studies conducted at the two environments. The role of the circulatory system was emphasized again in the changes observed during the cooling period. After heating was discontinued, the surface and subcutaneous temperatures dropped precipitiously while the muscle temperature rose sometimes to double the elevation observed while heating. In a number of instances the subcutaneous temperatures continued to rise for a short time after heating was discontinued. This was related to the conduction or transfer of heat from the maintained hot skin to the deeper tissues. This redistribution of heat may be of greater importance to therapy than the initial heating. These cooling curves are being examined mathematically, and the

4. Bierman, W.: Arch. Phys. Med. 14:717, 1933.
5. Sonne 1b. Bierman 4. Gersten, Wakim, Stow and Porter 3

results of the analysis will be presented later. The total energy input into the tissues appeared to have an important effect on the cooling rate.

Regardless of wavelengths, the heat delivered by infrared sources was mainly concentrated at the surface. Deep temperatures were seldom found that exceeded those at the surface. It would appear that if heat, and heat alone, was desired no spectral band possessed much advantage over another. However, if rate of heating or maximum effect at certain levels was a matter of importance, then some slight advantages accrued to one source and other slight advantages accrued to another. However, the temptation to agree with Laurens and Foster[16] that the infrared bands produced similar heating effects is great.

Conclusions

Infrared energy is primarily a means of delivering heat to the tissues, and, as such, grouping into spectral bands does not appear to be justified. However, for conventional therapy no marked advantage favors far or near red sources, since the final determinants are total energy delivered and effectiveness and patency of circulation. The far infrared sources were able to penetrate the subcutaneous tissues directly, while the near infrared could extend into the deeper tissues only through the medium of conduction and circulatory distribution. This may influence therapy only when in some particular instance rapid elevation of subcutaneous temperatures is necessary.

The discussion of this paper will appear in a later issue of the ARCHIVES.

LOCAL EFFECTS OF MICROWAVE RADIATION ON TISSUES IN THE ALBINO RAT *

LEONARD ESSMAN, M.D.
NEW YORK, N. Y.
and
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Recently reported studies by Wise, Watkins and Castleman[1] concerning the effects of microwave radiation on bone growth in the growing albino rat describe unusual effects of thermal injuries characterized by extensive bone absorption and deep tissue changes. As an extension of these studies, this paper describes the local tissue changes following thermal injury due to microwave radiation. In the present study the lumbar area of the white albino rat was exposed to microwave radiation and the thermal effects compared grossly and histologically with similar exposure to infrared radiation. In this study particular attention was given to the underlying muscle rather than bone changes. The specific problem investigated was whether or not deep tissue injury could be produced with microwave radiation without microscopic or gross injury in the overlying skin and subcutaneous tissue. Relatively small areas of the lumbar region in approximately 75 albino rats were exposed to either microwave or infrared radiation, and the immediate post-irradiation effects on the skin and subcutaneous tissue and muscle were studied both grossly and microscopically.

Method

The hair over the lumbar area of the albino rat was clipped and depilatated with barium sulfide paste. The animals were anesthetized with intraperitoneal injection of pentobarbital sodium (Nembutal) solution. The denuded area was exposed to either microwave or infrared radiation.

When microwave radiation was employed a clinical microwave generator with a C reflector was used as the source of radiation. The exposed area was maintained constant in all animals by use of a Crooks' metal shield covering the animal completely, except for a small oval window over the right lumbar region, measuring approximately 1.5 by 0.5 cm. The metal shield was well padded with cotton, avoiding any contact of the metal with the animal's skin. The power output of the machine was maintained at 80 per cent of total power output. The reflector-to-skin distance varied from 1 to 5 cm. in various animals, and duration of exposure was fifteen minutes in all cases. Surface temperatures of the lumbar region immediately before and after exposure to microwave radiation were made, a constatin-iron thermal junction being used.

When infrared radiation was employed, a 250 watt infrared bulb placed at distances varying from 10 to 16 cm. from the exposed surface was used for a period of fifteen minutes. In these cases the animal was shielded with a ½ inch (1 cm.) thick asbestos board containing a window approximately 1.5 cm. in diameter, thus allowing for exposure over the right lumbar region. A water bath over the asbestos board maintained a cool temperature except for the exposed area. Measurements of skin temperature were made before, during and after irradiation.

Gross examination of the animals was made immediately after exposure, one hour, two hours, one week, two weeks and three weeks later. At varying intervals appro-

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† From the Mauriania Hospital (Dr. Essman) and the George Washington University (Dr. Wise).
‡ Read at the Twenty-Seventh Annual Session of the American Congress of Physical Medicine, Cincinnati, Sept. 9, 1948.
1. Wise, C. S.; Castleman, B., and Watkins, A. L.: Effect of Diathermy (Shortwave and Microwave) on Bone Growth in the Albino Rat, J. Bone & Joint Surg. 31-A:487 (July) 1949.

priate animals were killed, and gross and microscopic changes in the skin and subcutaneous tissue and lumbar muscles were observed.

Results

With microwave radiation it was found that the precise dosage necessary to produce a predictable thermal lesion was not always possible. This was due particularly to the short distances between the source of radiation and skin required over the small exposed area. When lesions were produced they were classified as "minimal," "moderate" or "severe."

In 7 animals exposed to microwave radiation at a distance of 4 cm. for fifteen minutes the final skin temperatures immediately after exposure ranged between 44 and 50 C. The resulting lesions were classified as "minimal." These lesions consisted of a well circumscribed edematous patch usually containing a few petechial hemorrhages. The edema usually subsided within one to two hours following exposure, and on gross examination twenty-four hours later there did not appear to be any gross evidence of tissue destruction except for the petechial hemorrhagic areas. In none of the animals killed at varying intervals following exposure to microwave radiation was there gross evidence of tissue necrosis of either the skin or underlying tissues. Microscopic studies of selected animals verified the gross findings. There was no microscopic evidence of significant deep tissue changes which could be explained on the basis of thermal injury in any of these animals.

In a group of approximately 20 animals in which skin temperatures of 50 to 55 C. obtained after microwave irradiation, "moderate" to "severe" burns were produced. "Moderate" thermal injury consisted of a central area of necrosis and tissue coagulation involving the skin and subcutaneous tissues, with edema and inflammatory reaction in the surrounding superficial and deep tissues. In the "severe" thermal injuries the area of necrosis was extensive, involving the underlying muscle tissues with proportionately greater inflammatory response around the involved areas. In both of the latter groups varying degrees of secondary inflammation and infection were observed, varying from a mild superficial infection around the necrotic area to an extensive deep purulent area with sloughing of considerable tissue. Gross sections of the animals where "moderate" to "severe" thermal injuries had been produced showed the usual findings of a third degree burn.

In animals exposed to infrared radiation comparable burns were produced with tissue changes similar to those previously described between temperatures of 44 and 50 C. The "minimal" lesion showed edema and petechiae with rapid resolution of the edema within several hours and no gross or microscopic changes left on the surface or underlying tissues. With more intense infrared radiation, resulting in higher skin temperatures, "moderate" to "severe" burns were produced with approximately the same degree of tissue destruction as previously described. Figures 1 and 2 show typical lesions produced by microwave irradiation in selected animals.

The one difference noted in these two groups, but which could not be quantitatively evaluated, was the extension of the "moderate" to "severe" burns in the deeper underlying tissues with microwave irradiation as compared with infrared radiation. Figure 3 shows microscopic sections taken approximately one week after exposure to microwave irradiation showing the overlying necrotic and coagulated tissue with extension of the tissue necrosis into the lumbar muscle group with a surrounding inflammatory zone. Notable is the deep extension of the thermal injury in this instance as compared with figure 4 showing typical third degree burn produced with

infrared radiation. In both these instances the overlying skin injury, the area of tissue coagulation, etc., were similar. It is to be noted that the extension of the thermal injury into the deeper structures appears to be con-

Fig. 1. — Representative thermal lesions immediately following microwave irradiation. The maximum skin temperature reached in *A* was 54 C., in *B* 53 C. and in *C* 50 C. In *A* and *B* gross and microscopic evidence of changes in skin and underlying tissues was present when the animals were sacrificed, one week later; in *C* no gross or microscopic changes were evident one week later.

siderably more prominent in the microwave-exposed animals. In all instances where infrared radiation burns extended into the underlying muscles and which were classified as "severe" the overlying skin lesions were consider-

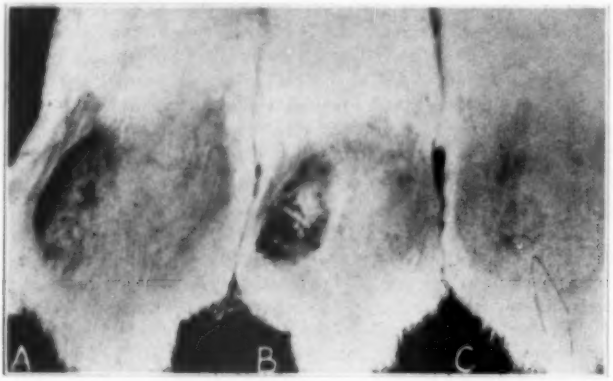

Fig. 2. — Same animals as in figure 1. *A* and *B* showed extensive injury into the underlying muscle tissue; *C* showed no evidence of damage to deep tissues at the time that it was sacrificed.

ably larger in extent, involving greater area of skin coagulation and necrosis than in the comparable lesions when microwave irradiation was used.

Comment

In view of the difficulties encountered in obtaining accurate dosage, particularly with microwave radiation, it is not possible to evaluate resulting

lesions statistically or quantitatively and compare with any great degree of accuracy the depth of thermal injury produced with microwave, as compared to infrared, radiation. This is particularly true in the small experimental

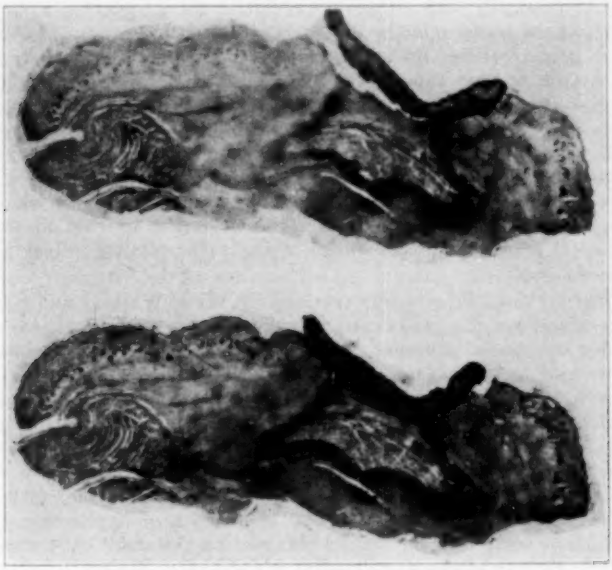

Fig. 3. — Microscopic section of a thermal lesion one week after microwave irradiation, showing extension of the burn into the underlying muscle.

animal used. The interesting and important negative finding, however, is the absence of either gross or microscopic evidence of any deep tissue or subcutaneous changes in animals receiving minimal thermal burns following microwave irradiation which were observed for a period of three weeks or longer. Stated in another way, it may be said that under the conditions

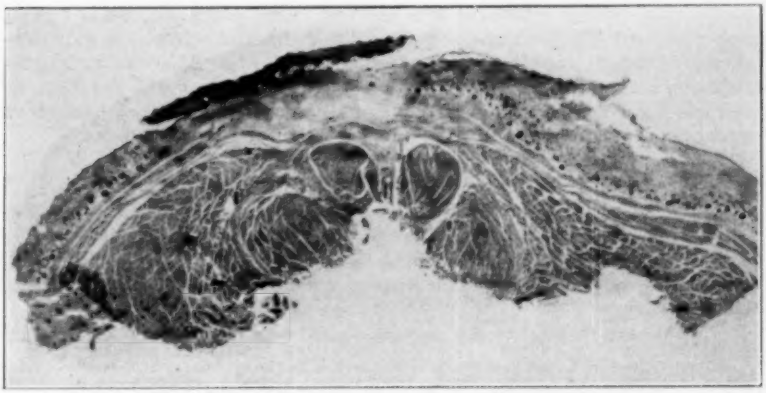

Fig. 4. — Microscopic section of a thermal lesion one week after infrared irradiation, showing extensive coagulation and necrosis of skin and subcutaneous tissue with very little extension into the underlying muscle.

of this experiment it was not possible to produce thermal lesions in the underlying subcutaneous or muscle tissue with use of microwave irradiation unless there was gross evidence of thermal injury to the superficial skin layers. There is also reported the qualitative finding that where thermal injury was produced with microwave radiation there appeared to be greater extension of the lesion into the underlying tissues than when infrared radiation was used. Studies by other workers[2] have shown that there is some evidence, both in vivo and in vitro, that elevated temperatures in the deep layers give rise to the theoretical possibility that deep tissue burns might be produced in the absence of any appreciable superficial thermal injury to the skin. The 12 cm. microwave radiation upon entering tissue is attenuated to approximately 2 to 3 cm. in wavelength. This would allow for the occurrence of reflection phenomena or standing waves in tissue in which layers have approximately the latter dimension. It might be that in the larger experimental animal or in the human being such standing waves and deep burns could occur.

In the previous experiments reported by Wise, Watkins and Castleman, the extensive bone changes occurring in the absence of marked skin destruction when microwave radiation was used may be the result of some reflection phenomena at the bone-soft tissue interphase. In experiments on dogs reported by Osborne and Frederick[2a] recently, it was stated that in certain experiments the final depth temperature at 1½ inches following exposure to microwave radiation was greater than the temperature in subcutaneous tissue or at a depth of 1 inch. In a personal communication from the Raytheon Laboratory concerning the irradiation of nonliving muscle tissue the maximum temperatures were recorded at a depth of approximately 2 cm. It would thus seem that the results obtained on the small experimental animal cannot be interpreted when applied to the human subject, in whom tissue layer dimensions are of considerably greater magnitude. Under the conditions of the experiments reported herein, however, it does appear that it is not possible to produce deep tissue damage in the absence of significant gross evidence of thermal injury to the overlying skin. Apparently greater extension of the burns into the deep tissues, when thermal injury does occur confirms previously reported clinical and experimental findings of deeper penetration of this type of radiation, allowing for more effective heating of the deeper tissues than accomplished with the usual infrared radiant heat. Skin temperature studies correlated with thermal injury when microwave irradiation was used did not show any remarkable difference from the skin temperature changes correlated with thermal injury when exposure to infrared radiation was used. This would imply that the skin sensation of heat appears to be an adequate safeguard against thermal injury or deep burns from microwave radiation, and this is in accord with our clinical findings.

Conclusions

1. Under the conditions of the experiment reported herein, using microwave irradiation to a local area in the lumbar region of the albino rat, it was not possible to produce any gross or microscopic evidence of deep tissue thermal injury in the absence of gross or microscopic evidence of superficial thermal burns.

2. Where thermal injury was produced with microwave radiation, the

2. (a) Osborne, S. L., and Frederick, J. N.: Microwave Radiation: Heating of Human and Animal Tissues by Means of High Frequency Current with Wavelength of Twelve Centimeters (the Microtherm), J. A. M. A. 137:1038 (July 17) 1948. (b) Rae, J. W., Jr.; Herrick, J. F.; Wakim, K. G., and Krusen, Frank H.: A Comparative Study of the Temperatures Produced by Microwave and Short Wave Diathermy, Arch. Phys. Med. 30:199 (April) 1949.

extension of the tissue injury as evidenced by gross and microscopic tissue examination was deeper and more extensive in microwave radiation in relation to the superficial lesion than that in similar animals irradiated by infrared radiation.

3. Skin temperature measurements under these conditions indicate that the thermal threshold for superficial burns with microwave irradiation compares with the skin temperature threshold for tissue damage with infrared radiation.

4. The results of the experiment confirm previous studies and clinical observations concerning the deeper penetration and thermal effects of microwave radiation as compared with infrared radiation.

Discussion

Dr. H. M. Hines (Iowa City): The findings by Dr. Wise on the local effects of microwave radiation on tissue in the albino rat are in accord with those of other investigators — namely, that the effects of irradiation with microwaves are due either primarily or exclusively to their thermogenic properties. No clearcut evidence for athermal effects of microwaves has come to my attention.

It would appear from the evidence presented by Miss Murphy at the Wednesday morning session and from previous studies by some, but not all, investigators that the most pronounced rise in tissue temperature occurs in superficial rather than in deeper tissues. In general, it appears that a greater rise in temperature occurs in superficial tissues with high frequency short wave irradiations than with the longer wavelengths employed in short wave diathermy. This does not mean that the superficial tissues will always exhibit a higher temperature than that found at the same time in deeper tissues; it means only that the increment of increase is greater in the former than in the latter. Differences in the composition, the blood and in the volume of blood flow through deep and superficial tissues, as well as differences due to heat exchange with the environments, preclude quantitative estimations of the amount of heat produced during the irradiation of living tissue.

A NEW METHOD FOR ERGOMETRIC MEASUREMENTS *

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The ergometers commonly used in physical medicine measure either the steady state work done, the continuous power developed or the static force exercised by a muscle or a muscle group. Measurements of this kind are sufficiently indicative for many requirements of the medical practice; however, they do not permit the direct measurement of transient muscular forces. Such transient forces arise, for instance, when a load is moved from one position to another. Throwing of an object and/or kicking are examples where such transient forces occur, even the short movement of a limb belongs in the category of transient movements.

These transient muscular forces can be measured conveniently by differentiation of the position function of the limb or of the load moved. This may be explained by the example of figure 1*a*. An object or a limb in the position *A* is moved by muscular force into the position *B* during the time $t_1 - t_2$. The entire moving process is then described by the curve 1*a*. Outside of the time $t_1 - t_2$ the muscular force is assumed to be zero or negligible. The curve 1*a* is differentiated in figure 1*b*. This curve, the derivative of curve 1*a*, shows the rate of change (slope) of the position function 1*a*. This is the velocity of the movement. In this particular example the velocity increases at t_1 from zero to a maximum and is then reduced to zero at the time t_2. Figure 1*c* shows a second differentiation, i. e., the rate of change of the velocity is plotted versus the time. This curve represents, therefore, the acceleration of the movement. Once the acceleration is known, the muscular force causing it can be easily found from Newton's law, which states force is equal to mass times acceleration. It is necessary, for absolute measurements, to know only the mass being moved. For comparative measurements even this figure need not be known, provided it is kept constant.

The muscular force is directly proportional to the second derivative of the position-time function, and the measurement of such forces in transient movements, therefore, is possible in principle. However, the method is practical only if the double differentiation can be accomplished automatically. This is conveniently possible if the movement is tranformed into an electrical voltage, as shown in the example of figure 2. The transient process consists here of the displacement of the mass *M* which slides with negligible friction on a rod *S*. The mass is mechanically coupled with the sliding contact of a potentiometer *P*. A voltage source is connected to the input terminals of the potentiometers. The output voltage between *A* and *B* changes as the mass *M* is moved. The differentiation of this voltage can be accomplished with a capacitor C_1, and a resistor R_1 connected as shown. It is well known[1] that, within limits, the output voltage at *D-E* arising across the resistor R_1 is proportional to the rate of change of the input voltage at *A-B*. The differentiation process is repeated by a second capacitor C_2 and resistor R_2 from which the output is fed into the

* From the Department of Biology, Massachusetts Institute of Technology.

1. Greenwood, I. A., Jr.; Holdam, J. V., Jr., and Macrae, D., Jr.: Electronic Instruments, Massachusetts Institute of Technology, Radiation Laboratory Series, New York, McGraw Hill Company, 1948, vol. 21, chap. 4.

meter or recorder T. The indication of this meter is then at any time directly proportional to the muscular force causing the displacement of the mass M.

There are several advantages connected with the use of this method. The electrical indication makes possible a recording of the instantaneous forces,

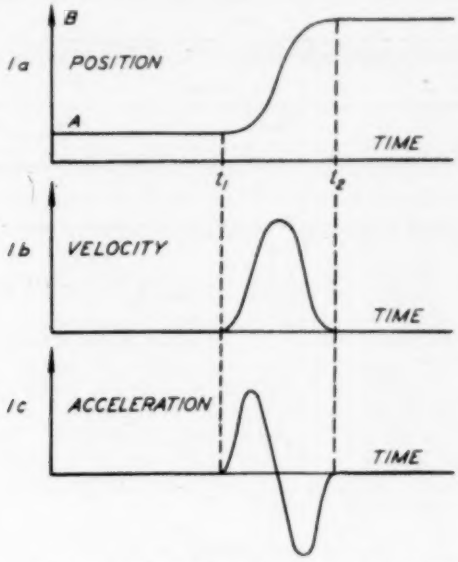

Fig. 1. — Position, velocity and acceleration of a mass in a transient ergometer.

as well as direct reading of the peak and the average force. The transformation of the position or the displacement into a proportional electric voltage can be accomplished with a great variety of means, such as strain gauges or other transducers. For some cases photoelectric arrangements may even be used

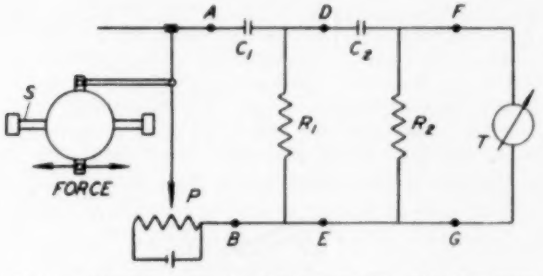

Fig. 2. — Schematic diagram of a transient ergometer. The output meter T measures the muscular force causing the displacement of the mass M.

as movement pick-ups, so that no mechanical connection need exist between the patient and the ergometer arrangement.

An interesting application of this method is the ergometric testing of the extrinsic ocular muscles.[2] The transformation of the position of the eyeball into a corresponding voltage is hereby particularly simple, since a permanent polarization exists generally between the cornea and the retina.[3] A DC voltage arises, therefore, between two electrodes attached to the subject's temple.[4] The magnitude of this voltage depends upon the angular deflection

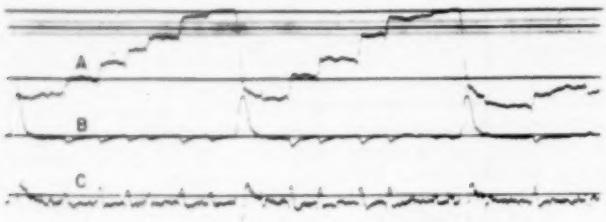

Fig. 3. — A, position; B, velocity, and C, acceleration, of the eyeball of a subject reading a line of print.

of the eyeball and varies between 0 and about 100 microvolts. With these small input voltages special technics are required to amplify and record the signal. Voltage amplification is required at the input, points *A-B* of figure 2, and after each step of differentiation, points *D-E* and *F-G;* power amplification may be required at the input to the recorder, points *F-G*. Figure 3 shows a record of the eye position, velocity and acceleration of a subject reading a line of print. The curve *C* indicates the forces of the extrinsic ocular muscles which accelerate and decelerate the eyeball.

Summary

The principle of an ergometer for transient muscular forces is described. The muscles or muscle groups to be tested cause the displacement of a load. The movement is transformed into a voltage which is electrically differentiated two times. The output voltage is proportional to the acceleration of the movement and, therefore, also proportional to the muscular force causing it. Results of such ergometric tests on the extrinsic ocular muscles are presented.

2. Powsner, E. R., and Lion, K. S.: Testing Eye Muscles, Electronics, 96, 1950 (March).
3. Mowrer, O. H.; Ruch, T. C., and Miller, N. E.: The Corneo-Retinal Potential Difference as the Basis of the Galvanometric Method of Recording Eye Movements, Am. J. Physiol. **114**:423, 1928.
4. Fenn, W. O., and Hursh, J. B.: Movements of the Eyes When the Lids Are Closed, Am. J. Physiol. **110**:8, 1937.

ELECTROPHORETIC ANALYSES OF PLASMA AND SERUM PROTEINS IN RHEUMATOID ARTHRITIS *

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and

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Changes in the plasma proteins in rheumatoid arthritis have been observed with the aid of both physical and chemical fractionation methods. Davis[1] in 1936 subjected the serum of 15 patients with advanced rheumatoid arthritis to the fractionation procedure of Howe. He noted a moderate decrease in albumin and an increase in globulin, particularly in the euglobulin fraction. The plasma fibrinogen exhibited a slight increase but was not proportional to the increase in total globulins. In 2 cases of Still's disease (juvenile form of rheumatoid arthritis), Taussig[2] reported a decrease in albumin and an increase in euglobulin.

The development of a suitable apparatus for the electrophoresis of plasma proteins in 1937 by Tiselius[3] and its modification by Longsworth[4] added physical methods of separation to the study of plasma proteins in rheumatoid arthritis. Svartz[5] observed an increase in the α and γ globulins while Lovgren[6] found a slight decrease in albumin associated with a definite increase in γ and a possible increase in β globulin by electrophoretic methods.

In a study of 7 cases of chronic rheumatoid arthritis, Malmros and Blix[7] reported a moderate decrease in albumin and an increase in globulins. The α globulin fraction was increased in 6 cases, the γ globulin in 4, while fibrinogen showed an increase in all 7 patients. Dole and Rothbard[8] made a series of electrophoretic patterns of the serum of 1 patient during various stages of rheumatoid arthritis. In the active stage, they noted a definite decrease in albumin accompanied with a marked increase in α_1, α_2 and γ globulins. In general, these changes reverted to normal as the disease became quiescent.

Three short summaries of electrophoretic investigations of rheumatoid arthritis have appeared in the last three years, but no data have been presented for comparison of their results. Perlmann and Kaufman[9] in 1946, in a study of 23 patients with this disease, observed an increase in α globulin in the early stages followed by an increase in γ globulin in the later stages. They also noted a change toward normal values as the patient improved. At the Seventh International Congress on Rheumatic Diseases in June, 1949, Olhagen[10] reported on electrophoretic analysis of plasma proteins in rheumatic diseases. The active stage of rheumatoid arthritis was characterized

* From the Department of Biochemistry and the Division of Physical Medicine, College of Medicine, State University of Iowa.

* Read at the Twenty-Seventh Annual Session of the American Congress of Physical Medicine, Cincinnati, Sept. 9, 1949.

* Aided in part by grants from Institute for Study of Analgesic and Sedative Drugs, and Bristol-Myers Company.

1. Davis, J. S.: J. Lab. & Clin. Med. **21**:878, 1936.
2. Taussig, A. E.: J. Lab. & Clin. Med. **23**:833, 1938.
3. Tiselius, A.: Tr. Faraday Soc. **33**:524, 1937.
4. Longsworth, L. G., and MacInnes, D. A.: Chem. Rev. **24**:271, 1939.
5. Svartz, N.: Nord. med. **18**:673, 1942; ibid. **23**:1713, 1944.
6. Lovgren, O.: Acta med. Scandinav. supp. **163**:61, 1945.
7. Malmros, H., and Blix, G.: Acta. med. scandinav. supp. **170**:294, 1946.
8. Dole, V. P., and Rothbard, S.: J. Clin. Investigation **26**:87, 1947.
9. Perlmann, G. E., and Kaufman, D.: J. Clin. Investigation (Proc.) **25**:931, 1946.
10. Olhagen, B.: In Proceedings of the Seventh International Congress on Rheumatic Diseases, 1949, p. 113.

by a decrease in plasma albumin and an increase in γ globulin and fibrinogen. At the same meeting, Armas-Cruz and co-workers[11] reported electrophoretic studies on paired samples of serum and plasma from patients with rheumatoid arthritis and spondyloarthritis ankylopoietica. They used a phosphate buffer (*p*H 7.4), which does not give as satisfactory a resolution of electrophoretic patterns as the barbiturate buffer employed by most investigators. No data or conclusions were presented, although these investigators stated that their results appeared similar to those of Svartz and Olhagen.

In view of the relative scarcity of data on serum or plasma of patients with rheumatoid arthritis obtained by the most recent electrophoretic technic, it was thought of interest to investigate changes in plasma proteins in the disease by this method. This paper presents a study of plasma and of plasma-serum pairs obtained from patients in various stages of rheumatoid arthritis. The data were compiled as part of an extensive electrophoretic investigation of plasma proteins in rheumatic diseases.

Experimental Procedures

Samples of plasma and serum were obtained from either oxalated or untreated blood from patients with rheumatoid arthritis. The plasma or serum was diluted with 3 volumes of a barbiturate buffer (*p*H 8.6, ionic strength 0.1) and dialyzed in Visking casings at 2 to 6 C. for three days with daily change of buffer. Electrophoresis was carried out in the Longsworth[12] modification of the Tiselius[3] apparatus with use of the long center section analytical cell. The current was maintained at a value of 25 ± 0.5 milliamperes for 120 ± 1 minute. The patterns were photographed and projections (2.5×) were traced on bond paper. The area enclosed by the base line and the protein peaks was measured with a planimeter and equated to total protein. Each peak was measured separately to determine values for individual components. Mobility measurements were made from the center of the boundary anomaly of each pattern.

Results and Comment

Table 1 shows typical values of the percentage composition of the plasma proteins from the group of 46 patients varying in age from 3 to 89 years who had had the disease from one to twenty years. The normal values are averages from several subjects and for pooled normal plasma reported from this laboratory[13] and others.[14] An electrophoretic pattern of normal plasma is shown in chart 1. It can readily be seen from the table that albumin is decreased from normal in rheumatoid arthritis. The plasma globulin fractions also show marked changes. On the average, the β globulin fraction exhibits only a slight increase over normal, whereas the α_1 and α_2 globulins show a marked increase as does the γ globulin. The increase in fibrinogen is greater than that of any of the other plasma proteins. Charts 2 and 3 present typical electrophoretic patterns of rheumatoid arthritis. In general, the most marked changes in the plasma proteins occurred in the active stage and in the most advanced cases of the disease. Many of the patients had had the disease for several years; for example, patients M. S., a woman aged 41, and H. P., a man aged 51, had rheumatoid arthritis for fifteen and eighteen years, respectively. Their plasma proteins showed marked changes characteristic of the disease. For the past several years, patient M. S. has led a vigorous farm life, has consumed a good diet, has been afebrile and has shown a normal sedimentation rate.

11. Armas-Cruz, R.; Madrid, M.; Lobo-Parga, G.; Valenzuela, F.; Meredith, C. J., and Gostin, L.: In Proceedings of the Seventh International Congress on Rheumatic Diseases, 1949, p. 145.
12. Longsworth, L. G.: Chem. Rev. **30**:323, 1942.
13. Dryer, R. L.; Paul, W. D., and Routh, J. I.: Proc. Soc. Exper. Biol. & Med. **66**:552, 1947.
14. Dole, V. P.: J. Clin. Investigation **25**:705, 1946. Armstrong, S. H., Jr.; Budka, M. J. E., and Morrison, K. C.: J. Am. Chem. Soc. **69**:1416, 1947.

Nine of the patients had more than one plasma sample analyzed. Of interest in this connection is the series of eight patterns obtained on patient O. H., a boy aged 14, over a period of eight months. The first pattern, shown in chart 4, was obtained in the active stage of the disease, and the last

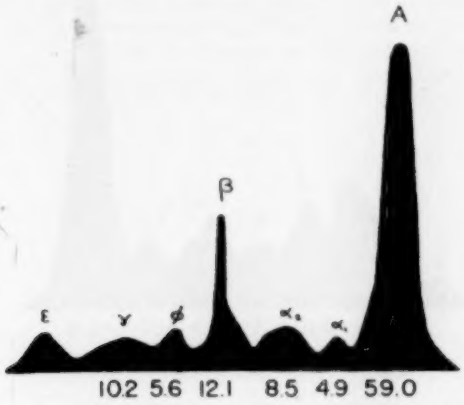

Chart 1. — Electrophoretic pattern of normal plasma. The percentage of each component is shown below its peak in the pattern.

(chart 5) was obtained during marked clinical improvement. A comparison of the values for Nov. 1, 1948 and June 30, 1949 reveals an increase in albumin and a decrease in fibrinogen and globulin fractions as the patterns

TABLE 1. — *Percentage Composition of Plasma Proteins in Rheumatoid Arthritis.*

Patient	Sex	Age	Date	Albumin	Globulin				
					α_1	α_2	β	δ	γ
K. S.	♀	3	5/ 5/47	38.3	5.1	13.7	14.1	8.6	20.2
J. Y.	♀	6	3/ 8/48	36.3	7.7	13.2	15.2	9.7	17.9
A. M.	♀	9	1/21/49	39.3	3.9	11.3	12.8	10.5	22.2
V. C.	♂	10	7/23/48	46.6	5.9	8.9	12.6	10.4	15.6
O. H.	♂	14	11/ 1/48	29.2	14.3	15.6	16.9	10.5	13.5
O. H.	♂	14	1/24/49	37.5	10.0	13.2	12.1	12.9	14.3
O. H.	♂	14	4/10/49	41.7	6.5	13.5	13.5	9.1	15.6
O. H.	♂	14	6/30/49	58.0	4.5	12.4	7.7	7.0	10.4
D. H.	♀	23	6/ 2/49	46.8	5.8	11.3	12.3	6.8	17.0
M. K.	♂	30	7/29/47	43.8	6.8	14.0	11.2	7.6	16.6
G. J.	♀	36	11/10/48	28.4	7.0	8.1	10.5	11.3	34.6
M. S.	♀	41	7/18/49	42.6	6.7	12.9	8.3	9.9	19.6
R. A.	♂	38	8/26/49	44.2	9.0	13.2	10.7	8.2	14.7
A. E.	♀	59	2/20/49	39.4	6.9	13.8	11.5	9.6	18.8
H. W.	♂	54	6/ 2/49	29.6	12.5	21.2	8.3	13.7	14.7
C. P.	♀	74	8/13/49	43.9	4.4	11.3	15.2	10.8	14.4
Average for 46 patients (63 plasma samples)				43.1	6.9	12.6	12.8	9.1	15.5
Average for 3 groups of normal persons				59.0	4.9	8.5	12.1	5.6	10.2

progress toward that of a normal person. The results in this series are in accord with those of Dole, and Rothbard,[8] mentioned earlier.

Table 2 presents typical data obtained from a comparison of plasma and serum pairs of 18 patients with rheumatoid arthritis. When compared with

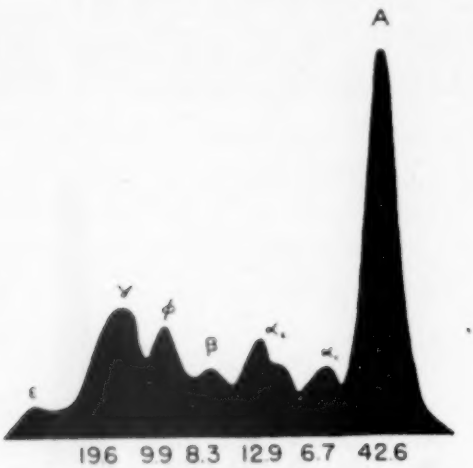

Chart 2. — Electrophoretic pattern of plasma from patient M. S., a woman aged 41, July 18, 1949.

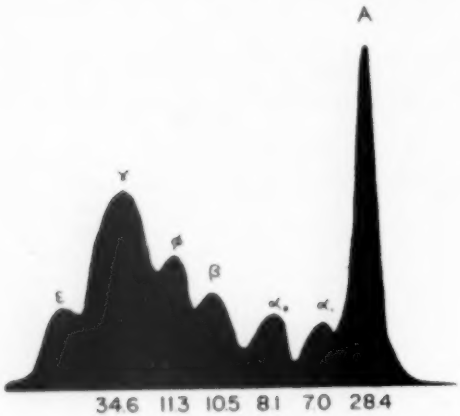

Chart 3. — Electrophoretic pattern of plasma from patient G. J., a woman aged 36, Nov. 10, 1948.

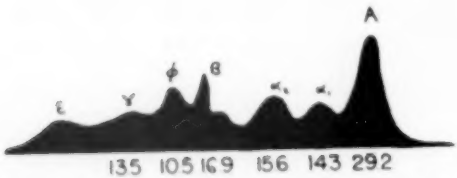

Chart 4. — Electrophoretic pattern of plasma from patient O. H., a boy aged 14, Nov. 1, 1948.

the average values for normal plasma proteins in table 1, the data from the pairs correspond closely to those given by the plasma samples. The plasma and the serum samples obtained from 9 normal persons and included in table 2, have a higher α_2 globulin and a lower β globulin fraction than the plasma from three groups of normal persons reported in table 1. For this reason, the α_2 globulin component shows little change, whereas the β globulin is markedly increased when the paired samples from patients with rheumatoid arthritis are compared with the pairs from the 9 normal individuals. It is probably more significant to compare all the values obtained from patients

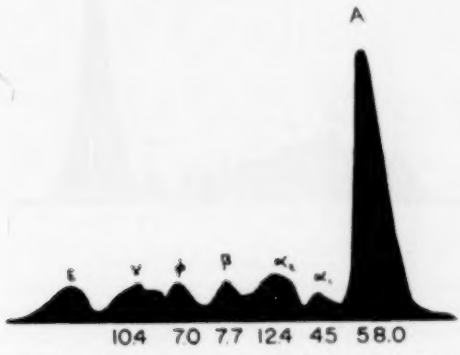

Chart 5. — Electrophoretic pattern of plasma from patient O. H., June 30, 1949.

TABLE 2. — *Analysis of Plasma and Serum Proteins in Rheumatoid Arthritis.*

Patient	Sex	Age	Sample	Albumin	Globulin					
					α_1	α_2	β	δ	γ'	γ
P. Mc.	♀	25	Plasma	48.3	7.0	11.2	9.5	7.3	....	16.7
			Serum	52.9	7.6	11.0	10.1	....	2.5	15.9
A. S.	♂	36	Plasma	43.0	5.1	14.7	16.3	9.1	....	11.8
			Serum	48.5	5.8	11.9	16.3	....	2.6	14.9
H. Mc.	♀	37	Plasma	46.1	4.6	11.0	10.0	6.7	....	21.6
			Serum	49.6	5.7	10.3	11.6	....	3.0	19.8
H. P.	♂	51	Plasma	41.8	7.2	13.1	12.3	8.3	....	17.3
			Serum	45.4	6.2	9.8	15.2	....	4.4	19.0
M. S.	♀	41	Plasma	42.5	7.8	10.7	10.5	10.5	....	18.0
			Serum	46.1	7.2	10.6	11.1	....	3.7	21.3
Average for 18 patients			Plasma	46.9	6.0	11.5	14.2	8.5	....	12.9
			Serum	50.1	6.4	10.7	14.8	....	2.9	15.1
Average for 9 normal persons			Plasma	59.4	4.3	10.3	8.9	6.6	....	10.6
			Serum	59.8	4.7	11.2	9.4	....	2.4	12.6

with rheumatoid arthritis with those obtained from the three groups of normal persons show in table 1, since the values for the α_2 and β globulin components of the normal pairs differ from the larger number of normal plasma values that have been reported by several investigators. The patterns of a typical pair of plasma-serum samples are shown in charts 6 and 7.

In the majority of the pairs, the serum albumin and γ globulin are increased over the same fraction in the plasma, while the other components show little difference. The new component γ' in serum has been shown to be a definite protein fraction by Deutsch, Alberty and Gosting.[15] They studied this fraction in normal serum and found that it represented about 3 per cent of the total protein. In a series of electrophoretic studies on liver disease in this laboratory,[16] the components of plasma-serum pairs of 9 normal

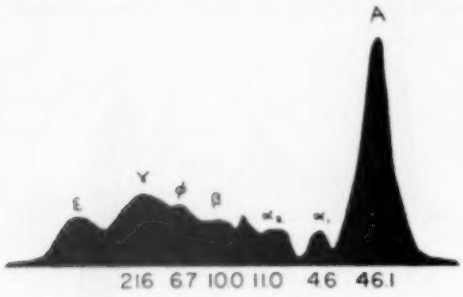

Chart 6. — Electrophoretic pattern of plasma from patient H. Mc., a woman aged 37, Aug. 6, 1949.

adults were determined. The averages of these normal pairs are included in table 2 for comparison with those from patients with rheumatoid arthritis. The value for the γ' component agrees with that of Deutsch and co-workers.

As yet, no reports have appeared in which changes in the γ' globulin have been studied in disease. Work in this laboratory indicates considerable variation from the normal in certain diseases of the liver. One of the major objectives in analyzing paired samples of plasma and serum in rheumatoid arthritis was to evaluate the γ' globulin fraction. Even though many of the serum samples contained an abnormally high γ globulin, the γ' globulin fraction in all cases remained close to normal, with an average of 2.9 per cent.

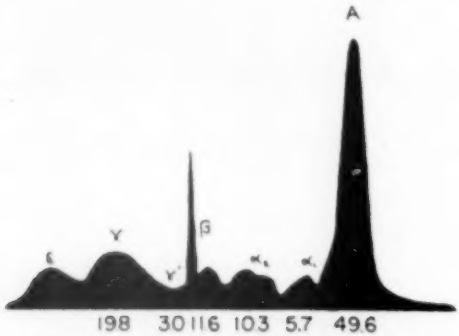

Chart 7. — Electrophoretic pattern of serum from patient H. Mc., a woman aged 37, Aug. 6, 1949.

15. Deutsch, H. F.; Alberty, R. A., and Gosting, L. J.: J. Biol. Chem. 165:21, 1946. Deutsch and his co-workers designated this new component as γ_1 and the regular gamma globulin as γ_2.
16. Unpublished data.

In limited experience with a few cases of rheumatoid syondylitis, it appears that the plasma proteins are more nearly normal than in rheumatoid arthritis. Investigation of plasma proteins in rheumatoid spondylitis is in progress.

A comparison of the results obtained in the present investigation with those from an extensive series of patients with rheumatic fever, in this laboratory,[16] reveals differences in the patterns from patients with the two diseases. In general, the changes in albumin, α_2 and γ globulins and fibrinogen are more marked in rheumatoid arthritis than in rheumatic fever.

Summary

Electrophoretic analysis of the plasma proteins of 46 patients and the plasma-serum pairs of 18 patients with rheumatoid arthritis has been carried out.

A marked decrease in albumin, a moderate increase in β globulin, and a marked increase in α_1 and α_2 and γ globulins and in fibrinogen compared with the values for normal plasma were observed.

A series of eight plasma patterns on 1 patient obtained over a period of eight months illustrate changes in plasma proteins that occurred from the active stage of the disease to marked clinical improvement.

The γ' globulin component of serum in rheumatoid arthritis was not increased over that observed in normal persons.

The plasma proteins of persons with long-standing rheumatoid arthritis, who have consumed a balanced diet for years, are still characteristic of the disease.

Discussion

Dr. H. M. Hines (Iowa City): The careful study carried out by Drs. Routh and Paul adds further evidence that rheumatoid arthritis is associated with an altered homeostasis. The significance of the altered plasma protein picture is not clear. The fact that remissions and responses to compound E are preceded or paralleled by shifts to normal patterns of plasma protein fractions emphasizes the generalized systemic nature of the disease. I should like to ask whether these workers would suggest that the lowered albumin fraction represents a compensatory response to the elevated globulin fractions, thereby preventing any appreciable change in the plasma oncotic pressure, or whether lowered plasma albumin fractions are tied up with deficient synthesis by the liver? May I ask what specific prognostic or diagnostic assistance the more elaborate electrophoretic analysis shows which is not revealed by the older fractionation methods and by sedimentation tests?

We are indebted to the Departments of Pediatrics and Orthopedics for their cooperation in obtaining plasma and serum samples.

A TRICEPS-SUBSTITUTE BRACE FOR QUADRIPLEGICS *

HENRY R. SHEAR, M.D.

and

A. ESTIN COMARR, M.D.

VAN NUYS, CALIF.

The ultimate objective of the treatment of patients with spinal cord injuries is to render them as independent as possible.[1] This task is especially difficult in quadriplegics who are extremely helpless. Fortunately, the biceps musculature, with its higher segmental motor supply, is spared in many cases while the triceps function is abolished at the same time.[2] The presented brace takes advantage of this condition and, by restoration the muscle equilibrium, allows for sufficient function of the elbow joint. This, in turn, permits the use of eating utensils, combs, brushes, etc., so important in daily life and so significant a factor for the improvement of the known behavior pattern[3] of patients with spinal cord injury.

Our brace has a threefold purpose: (*a*) It offers resistive exercise for the biceps; (*b*) it acts as a cock-up splint for the hand and (*c*) it furnishes an improved holder for eating devices than that previously described.[4]

Description

The triceps brace, including the detachable instrument holder, (weighs 11/5 pounds). It is made of 3/32 by 1/2 inch surgical steel and consists of four basic parts. These (figs. 1 and 2) are (*a*) an arm portion, with two bands, (*b*) an elbow portion (joint and spring with protective covering); (*c*) the forearm portion, with one band, and (*d*) the hand portion (instrument holder). In the arm segment the proximal band is rigid except for freedom to pivot in the long axis (fig. 1*A*). This band fits on the anterior surface of the arm (fig. 2). The distal band of the first segment is rigid and covers the posterior aspect of the arm (fig. 2). A leather strap, attached to the end of this band, encircles the arm and attaches to a buckle at the base of the band. The elbow joint is of the male-female hinge type (fig. 1*B*). An 8-32 1/4 inch pin, which is sunk through its center, keeps the joint intact. Laterally, a 7/16 inch pin, 3/8 inch high, is welded to the joint (fig. 1*B*). This pin is slotted and receives the center end of the spring (fig. 1*C*). The spring is an ordinary five-coil automobile door latch spring. The outer end is bent back and hooked to a 3/8 inch pin which is 1/2 inch in length and welded on the lateral side of the forearm portion of the brace (fig. 1*D*). A protective elk skin covers the joint. This cover slides along the forearm portion of the brace (fig. 1*D*). It is held in place by a hole which fits snugly over the pin. Another leather-covered metal band is rigidly attached at the distal end of the forearm segment and encircles snugly the anterior aspect of the wrist (fig. 2). From the flexor surface of this band projects another piece of surgical steel (1/8 by 1/3 inch), bent to conform to the contour of the wrist and hand in the cocked-up position (fig. 1*E*). The palmar portion is leather covered and curved around the lateral edges of the palm in order to support and stabilize the hand. It is mounted to the wrist portion in such a manner as to permit rotation through 360 degrees. This is accomplished by lathing a groove into the male portion of the joint, into which fits a screw through

* From the Paraplegic Service of Birmingham Veterans Administration Hospital.

* Sponsored by the Veterans Administration and published with the approval of the Chief Medical Directors. The statements and conclusions published by the authors are a result of their own study and do not necessarily reflect the opinion or the policy of the Veterans Administration.

1. Shear, H. R., and Comarr, A. E.: Eating Devices for the Paraplegic Patient, Occup. Therapy **28**:154, 1949.

2. Bing, R.: Compendium of Regional Diagnosis in Lesions of the Brain and Spinal Cord, ed. 11, translated and edited by Haymaker, W., The C. V. Mosby Company, St. Louis, 1940.

3. Thom, D. A.; von Salzen, C. F., and Fromme, A.: Psychological Aspect of the Paraplegic Patient, M. Clin. North America **30**:473, 1946. Weiss, F. G., and Bors, E.: Attitudes of Patients in a Paraplegic Center, J. Social Casework **29**:60, 1948.

4. Clarke, M. D.; McGovern, J. P., and Lee, W. J.: Self-Help Aids in Rehabilitation of Quadriplegic Patient, Occup. Therapy **27**:167, 1948. Gingras, G., and Hardy, G., Occupational Therapy and Quadriplegia, ibid. **27**:159, 1948. Lowman, E. W., and Lipham, F.: Occupational Therapy Aid for Paraplegics, Am. J. Occupational Therapy **1**:148 (June) 1947. Shear and Comarr 1.

the female portion. The under surface of the palmar portion carries the receptacle for the specially fitted fork, spoon or other instrument. A small leaf spring attached to each instrument fits into the receptacle and insures a tight fit (fig. 1*F*). All portions of the brace which contact the skin are covered with elk skin and padded with foam rubber.

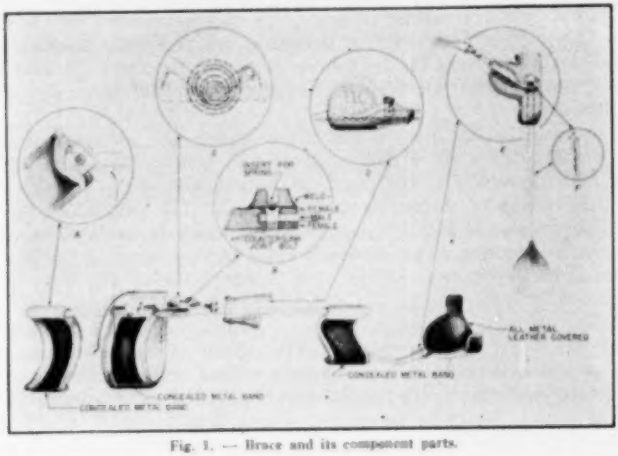

Fig. 1. — Brace and its component parts.

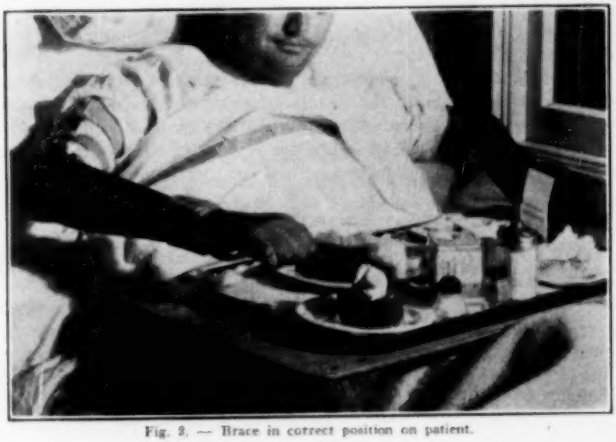

Fig. 2. — Brace in correct position on patient.

Comment

The return of paralyzed veterans of World War II has revived the interest in braces and orthopedic appliances here[5] and abroad.[6] Prior to this time available references were scarce.[7] Only a few prosthetic devices have been described for

5. Bors, E.: Spinal Cord Injuries, Veterans Administration Technical Bulletin, Washington, D. C., Dec. 15, 1948.
6. Guttmann, L.: Rehabilitation After Injuries to the Spinal Cord and Cauda Equina, Brit. J. Phys. Med. 1:17, 1946.
7. Kuhn, Wm. G.: The Care and Rehabilitation of Patients with Injuries of the Spinal Cord and Cauda Equina. A Preliminary Report on 113 cases, J. of Neurosurgery 4:40, 1947.

the upper extremities, among them an ingenious brace for use in palsy of the brachial plexus.[8]

The presented brace, developed by one of us (H. R. S.) fulfils the essentials of any brace as outlined by Lewin[9]: (*a*) It furnishes the highest degree of stability commensurate with the physical state of the patient; (*b*) it protects against imbalance caused by unequal pull of normal muscles against paralytic muscles; (*c*) it prevents further deformity by this imbalance; (*d*) it is light enough in construction to permit the patient to use it without undue fatigue; (*e*) it avoids pressure areas on the skin or bony prominences; (*f*) it is within the financial reach of the patient, or of an agency that will furnish it, without sacrificing durability.

The advantage of this brace is that it can serve many purposes. It permits resistive exercises of the elbow flexors in cases of poliomyelitis, cord injury or peripheral nerve lesion. The resistance can be adjusted to the strength of the biceps by lengthening or shortening the coil spring. The part which holds the implements serves also as a cock-up splint. It can easily be modified in order to fit the particular situation. The most important service rendered by this brace is that it enables a quadriplegic patient to eat instead of being fed. This function is accomplished by combining the stabilization of the hand, including the firmly attached eating utensils, with the fully utilized voluntary function of the residual strength of biceps and shoulder muscles. The rigidity of the wrist and forearm permits a patient with completely flail wrists to feed himself. This is superior to a previously described eating utensil which required some voluntary action of the wrist joint.[1] Attaching an electric shaver, pen or pencil, toothbrush or other personal articles of importance for daily use benefits the independence and morals of the patient. It is obvious that this brace must be fitted individually if maximum efficiency is expected.

Summary

A triceps-substitute brace is described which serves a threefold purpose in the constant endeavor to guide the paralyzed patient toward self dependency. It replaces the absent triceps function and restores the lost equilibrium to the elbow joints; it serves as a cock-up splint for wrist and hand and it permits the use of eating, writing or other devices essential for daily comfort.

8. Ward, G. E.; Bellman, H. R., and Wood, E. V.: A Device in Which Springs Replace the Action of Paralyzed Muscles of the Arm, J. Bone & Joint Surg. 30-A:987, 1948.
9. Lewin, R.: Infantile Paralysis, Philadelphia, W. B. Saunders Company, 1941.

We wish to express our appreciation to Mr. George W. Dietrich, of the Birmingham Veterans Administration Hospital Brace Shop; to Mr. Eugene Hallet, Department of Engineering of the University of California, Los Angeles, for technical advice, and to the medical illustrator and photographic department of the Birmingham Veterans Administration Hospital.

ARCHIVES of PHYSICAL MEDICINE

OFFICIAL PUBLICATION AMERICAN CONGRESS OF PHYSICAL MEDICINE

.·. EDITORIALS .·.

WHAT IS HAPPENING TO MASSAGE

Is massage a useful therapeutic measure? Recent reports from good investigators tend to cast doubt on the value of this time-honored physical agent. A study[1] on the changes in the blood flow was done by the Mayo group. The conclusions were these:

1. There is no consistent or significant average increase in total blood flow after deep stroking and kneading massage of the extremities, in normal subjects, in those with rheumatoid arthritis or in those with spastic paralysis of the extremities.
2. There is a moderate, consistent and definite increase in circulation after deep stroking and kneading massage to the extremities of subjects who have flaccid paralysis.
3. Vigorous, stimulating massage results in consistent and significant increases in the average blood flow of the massaged extremity.
4. Neither deep stroking and kneading massage nor vigorous, stimulating massage of the extremities results in consistent or significant changes in the blood flow of the contralateral unmassaged extremities.

The Northwestern University group found that "massage proved completely ineffective in delaving the loss of mass and strength of the anterior tibial muscle of the dog following experimental denervation of long duration."[2]

An earlier study from the Iowa University group found in denervated muscles that "massage caused only a slight retardation of weight loss but proved to be effective in maintaining the strength of denervated muscle."[3] These investigators believe from their observation that the most effective therapy for the treatment of paralyzed muscles is the combination of massage and electrical stimulation. This, at least, gives some credit to massage.

From this evidence it would appear that massage as ordinarily administered does not increase the blood flow to the part nor does it prevent the weight loss in denervated muscles.

Proof of the therapeutic value of massage and of its influence on certain physiologic changes has not been entirely lacking. Sporadic reports of basic research have appeared; however, the amount of laboratory work has not been sufficient nor the quality of critical examination always quite in keeping with a measure which has enjoyed such high repute. For those professional individuals in the field of physical medicine, massage has been universally accepted and most widely used. To many of these persons, merely questioning the value of massage might appear sacrilegious. Even for physicians who consider massage a form of rubbing, credit it with virtue and generally recommend it.

From antiquity massage has been accepted. The ancient Egyptian, Greek and Persian medical writings gave prescriptions for massage. Hippocrates' words are usually rated sufficiently authoritative as to demand attention. In 430 B. C. in discussing the treatment of a dislocated shoulder

1. Wakim, K. G.; Martin, G. M.; Terrier, J. C.; Elkins, E. C., and Krusen, F. H.: Effects of Massage on the Circulation in Normal and Paralyzed Extremities, Arch. Phys. Med. **30**:135 (March) 1949.
2. Kosman, A. T.; Wood, E. C., and Osborne, S. L.: The Effect of Massage upon the Denervated Skeletal Muscle of the Dog, Arch. Phys. Med. **29**:489 (Aug.) 1948.
3. Suskind, M. I.; Hajek, N. M., and Hines, H. M.: Effects of Massage on Denervated Skeletal Muscle, Arch. Phys. Med. **27**:133 (March) 1946.

following reduction, he wrote — "It is necessary to rub the shoulder gently and smoothly. The physician must be experienced in a great many things, but assuredly also in rubbing; for things that have the same name have not the same effects, for rubbing can bind a joint which is too loose and loosen a joint that is too hard." Quotations from Hwang-Ti in 2697 B. C. to the present time could be cited as the opinion of authorities for massage.

Among the more recent laboratories studies which testify to the merit of massage, the following are examples. A noteworthy one is that of Chor and associates,[4] who found that "the degree of regeneration of the peripheral nerve in Macacus rhesus monkeys is not actually influenced by the use of physical therapy measures. The condition of the remaining muscle is the important factor in determining the degree of muscle repair and recovery which follows the regeneration of the peripheral nerve" and they concluded that "massage and passive movement therapy appear to be the most beneficial."

As to capillary circulation, an earlier investigation[5] has shown the effect of external stimuli. Light pressure produces an almost instantaneous though transient dilatation of the capillary vessels, although heavier pressure may produce dilatation of more enduring nature. "Microscopic observation of fields in which only a few capillaries are open, and hence in which only a few can be seen, reveals that pressure of this kind may cause practically all the smaller vessels to become visible because of the blood flow created through them." To be sure, capillary vasodilatation is no guide to the changes occurring in the deeper and larger blood vessels. A cinematographic study done by Dr. E. R. Clark and E. A. Swenson, from the Department of Anatomy of the University of Pennsylvania, upon the ear of a rabbit showed actual changes in the vessel walls which permitted the passage of leukocytes. After massage there is an "increased rate of blood flow and a change in the vessel wall which is evidenced by a sticking and emigration of leukocytes. Massage is thus accompanied by an increased interchange of substances between blood stream and tissue cells, with an altered and presumably improved tissue metabolism." Further proof of the effect of massage on the lymphatics and circulatory system was the work of Bauer, Short and Bennett,[6] when they injected proteins into the joints of dogs and found a more rapid elimination of these substances through the lymphatics by mean of massage.

Many problems other than the effect of massage on the circulatory system might be scrutinized. The various types of technic now commonly employed could be more thoroughly evaluated as to specific physiologic changes. Will the influence of Dr. Mennell of London be threatened? His quotation, "never be afraid of rubbing too gently . . . the nature of the movement is little more than a caress performed with uniform speed and monotonous regularity," are revered words in many schools. The work of the Mayo group, cited in the first reference, shows at least that the less vigorous massage does not change the blood flow. Where is any proof of the optimum length of time a massage should be given?

Is there any value in the use of medicated ointments for counterirritation? The laymen apparently have faith in these ointments. Tons of the numerous advertised proprietary products are purchased yearly. To be sure, these purchases in themselves are not evidence of their efficacy. What drug is

4. Chor, H.; Cleveland, D.; Davenport, H. A.; Dolkart, R. A., and Beard, G.: Atrophy and Regeneration of the Gastrocnemius-Soleus Muscles, J. A. M. A. 113:1029 (Sept.) 1939.
5. Carrier, E. B.: Determination of Plasma and Hemoglobin Volumes After Unit Hemorrhages Under Controlled Experimental Conditions, Am. J. Physiol. 61:528, 1922.
6. Bauer, W. W.; Short, C. L., and Bennett, G. A.: Manner of Removal of Protein from Normal Joints, J. Exper. Med. 57:619, 1933.

capable of producing the greatest and longest amount of vasodilatation? As long ago as 1876, Drasche[7] showed that an alcoholic solution of salicylic acid applied to the skin caused an almost immediate appearance of salicylate in the urine. A more recent group of investigators[8] confirmed this work on human subjects and, in addition, showed in a rabbit's ear photoelectrically that the amount of hyperemia was greater when the ear was massaged with methyl salicylate than when no drug was used. The factors of skin penetration and absorption of various drugs are far more than mechanical ones; they involve many physicochemical and biologic considerations. Information is needed by detailed and controlled studies not only of the drug itself but of the vehicle in which it is absorbed, the area of the body massaged, the length of time and the difference of absorption from the various types of massage, and numerous other individualized problems. These questions and others would seem to demand more interest and investigation so as to establish definite facts.

The influence of massage on the central nervous system must not be overlooked. Light stroking massage is often prescribed as a sedative. It is also said to relieve spasm, produce relaxation and reduce pain. Where is the proof? Certainly patients will attest to its significant relief; however, is this purely subjective? Scientific means are now available to measure such factors objectively. Even if the effect is only subjective, isn't this psychologic benefit of considerable therapeutic value? Pain may be relieved by several different means. A study on the effect of counterirritation by various methods showed[9] that when tactile sensations were induced by rubbing the skin with cotton for its mild effect, it produced "temporary relief"; however it was less effective than cold, heat or electrical stimulation. The very nature of pain and the reaction it produces in different patients and in different diseases and disorders could be investigated so as to measure the alteration in the response of the pain threshold by various forms of massage.

The purpose of this editorial is neither to review all the literature, either old or new, about massage nor to weigh one argument against the other as to the relative merits of this agent, but to show that another measure in physical medicine is stimulating interest so as to secure precise knowledge. This is as it should be. Sufficient sound clinical research and enough basic scientific investigations will eventually aid in evaluating this physical agent. From such work much of the empiricism about massage will be removed. It will then be prescribed rationally and specifically because of its proved effects on various pathologic and psychologic processes. No longer will such a quotation be possible as the following from the pamphlet issued several years ago by the Council of Physical Therapy* of the American Medical Association on Massage: "There is probably no other measure of equal known value in the entire armamentarium of medicine which is so inadequately understood and utilized by the profession as a whole."

* Now Council on Physical Medicine and Rehabilitation.

7. Drasche, Wien. med. Ztschr. **26**:1049, 1876.

8. Beutner, R.; Calesmick, M. S.; Powell, E., and Bortin, L.: On the Absorption and Excretion of Methylsalicylate Administered by Inunction, J. Lab. & Clin. Med. **14**:1055 (Nov.) 1943.

9. Gammon, G. D., and Starr, I.: Studies on the Relief of Pain by Counterirritation, J. Clin. Investigation **20**:13 (Jan.) 1941.

MEDICAL NEWS

Report of the Finance Committee

The report of our auditor which follows indicates that for the year ending December 31, 1949 the American Congress of Physical Medicine continued to operate on a sound financial basis.

Frank H. Krusen, M.D., Chairman.
Roy W. Fouts, M.D.
Walter M. Solomon, M.D.

Report on Examination for the Year Ended December 31, 1949

April 17, 1950.

American Congress of Physical Medicine,
30 North Michigan Avenue,
Chicago, Illinois.

Dear Sirs:

We have examined the balance sheet of the American Congress of Physical Medicine as of December 31, 1949, and the related summary of net income and surplus for the year then ended. Our examination was made in accordance with generally accepted auditing standards and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances, except as stated in the following paragraph.

We did not verify the income from subscriptions to "Archives," a magazine published monthly by the Congress, because it was not considered practicable. However, we tested the correctness of the subscription income recorded on the books by reference to available supporting data.

Based on our examination, limited to exclude verification of "Archives" subscription income, in our opinion, the accompanying balance sheet and summary of net income and surplus present fairly the financial position of the American Congress of Physical Medicine at December 31, 1949, and the results of its operations for the year then ended in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

We submit the following exhibits:

Exhibit —

A — Balance Sheet, December 31, 1949.

B — Summary of Net Income and Surplus for the Year Ended December 31, 1949.

Yours truly,

George Rossetter & Co.

Exhibit A

American Congress of Physical Medicine
(Incorporated in Illinois — Not for Profit)
Balance Sheet, December 31, 1949

Assets

Current Assets:		
Cash in bank and on hand		$12,317.08
Accounts receivable:		
Advertisers and exhibitors	$ 738.00	
Members' dues	420.00	
American Registry of Physical Therapy Technicians	569.02	
American Board of Physical Medicine and Rehabilitation	1.12	
Total	$ 1,728.14	
Less reserve for possible losses	400.00	1,328.14
Investment in United States Savings bonds, Series G — at cost		20,000.00
Accrued interest		166.66
Deposit at United States Post Office		50.00
Total		$33,861.88

Liabilities

Current Liabilities:		
Accounts payable:		
New York Society of Physical Medicine	$ 15.00	
Exhibitor's credit balance	12.50	$27.50
Employees' income tax withheld		367.78
Total current liabilities		$ 395.28
Deferred Income:		
Subscriptions to "Archives" — unexpired portion	$ 6,761.72	
Dues collected in advance — year 1950	610.00	
Total deferred income		7,371.72
Surplus, per Exhibit B		26,094.88
Total		$33,861.88

Exhibit B

American Congress of Physical Medicine
Summary of Net Income and Surplus
for the Year Ended December 31, 1949

Income:		
Members' dues		$ 8,227.00
"Archives":		
Advertising	$ 6,337.66	
Subscriptions	11,750.04	
Sale of cuts, etc.	833.95	18,921.65
Interest on United States Government securities		500.00
Convention income:		
Exhibits	$ 5,650.00	

Special instruction course	2,000.00	
Banquet	1,014.00	
Total	$ 8,664.00	
Direct convention expenses	6,175.37	
Convention income — net		2,488.63
Miscellaneous		96.51
Total income		$30,233.79
Expenses:		
Office expenses and salaries	$18,266.06	
Printing "Archives"	11,156.90	
Cuts, half-tones, electros, etc.	960.57	
Telephone and telegraph	334.37	
Sectional meetings	9.00	
Educational conference	382.55	
Bank exchange	10.48	
Professional fees	541.21	
Provision for loss on uncollectible accounts	375.40	
Cash discounts to advertisers	164.99	
Moving	202.92	
Miscellaneous	100.06	
Total expenses	$32,504.51	
Less share of office expense billed to:		
American Society of Physical Medicine	$ 120.00	
American Registry of Physical Therapy Technicians	7,200.00	7,320.00
Expenses — net		25,184.51
Net income for the year		$ 5,049.28
Surplus at beginning of the year		21,045.60
Surplus at end of the year		$26,094.88

Report on Examination for the Year Ended December 31, 1949

April 17, 1950

Board of Registry,
American Registry of Physical Therapy Technicians,
30 North Michigan Avenue,
Chicago, Illinois.

Dear Sirs:

We have examined the balance sheet of the American Registry of Physical Therapy Technicians as of December 31, 1949, and the related statement of net income and surplus for the year then ended. Our examination was made in accordance with generally accepted auditing standards and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, the accompanying balance sheet and statement of net income and surplus present fairly the financial position of the American Registry of Physical Therapy Technicians at December 31, 1949, and the results of its operations for the year then ended in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year.

We submit the following exhibits:

Exhibit —

A — Balance Sheet, December 31, 1949.
B — Statement of Net Income and Surplus for the Year Ended December 31, 1949.

Yours truly,

George Rossetter & Co.

Exhibit A

American Registry of Physical Therapy Technicians

(Incorporated in Illinois — Not for Profit)

Balance Sheet, December 31, 1949

Assets

Current Assets:		
Cash on deposit		$ 8,829.44
Accounts receivable — dues	$ 326.00	
Less reserve for possible losses	150.00	176.00
Investment in United States Savings bonds, Series G — at cost		14,500.00
Accrued interest		116.65
Total		$23,622.09

Liabilities

Current Liabilities:		
Account payable — American Congress of Physical Medicine		$ 569.02
Accrued federal excise tax		10.80
Total current liabilities		$ 579.82
Deferred Income:		
Dues collected in advance — year 1950	$ 6,938.00	
Deposits with applications (subject to refund if applications are rejected)	10.00	
Total deferred income		6,948.00
Surplus, per Exhibit B		16,094.27
Total		$23,622.09

American Registry of Physical Therapy Technicians

Statement of Net Income and Surplus for the Year Ended December 31, 1949

Income:		
Dues		$ 7,788.50
Registration fees		4,476.00
Sales:		
Pins	$ 936.00	
Emblems	315.00	
Directory	152.15	1,403.15
Interest on United States bonds		362.50
Miscellaneous		5.50
Total income		$14,035.65
Expenses:		
Share of office expense billed by American Congress of Physical Medicine	$ 7,200.00	
Printing and multigraphing	1,168.59	
Directory	769.32	
Examinations — supervision and grading	258.00	
Board meeting	153.49	
Purchase of pins	502.50	
Office equipment and supplies	298.44	
Telephone and telegraph	32.26	
Postage	1.12	
Exchange	50.08	
Fidelity bond premium	25.00	
Professional fees	410.82	
Provision for losses on uncollectible dues	172.00	
Moving	232.93	
Purchase of emblems	233.25	
Miscellaneous	3.50	
Total expenses		11,511.30
Net Income for the Year		$ 2,524.35
Surplus at Beginning of the Year		13,569.92
Surplus at End of the Year		$16,094.27

Report of the Membership Committee

The Committee on Membership again reports with satisfaction a steady increase in the number of new members from all parts of the United States and abroad. At the meeting of the Congress, September, 1949, sixty-six applicants were elected to membership, with the following geographic distribution: New York, 7; Minnesota, 5; Georgia, Illinois, Iowa, Ohio and Texas, 4 each; California, Colorado, New Jersey, and Pennsylvania, 3 each; Missouri, 2; Arizona, Arkansas, District of Columbia, Florida, Indiana, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Mississippi, North Carolina, Oregon, Tennessee, Virginia, Washington, and Wisconsin, 1 each; abroad: Canada, 2, and Puerto Rico, 1.

The membership census on April 1, 1950, showed a total membership of 583, geographically distributed as follows:

State	Number of Members	State	Number of Members
Alabama	2	Nevada	1
Arizona	4	New Jersey	19
Arkansas	2	New York	130
California	31	North Carolina	7
Colorado	7	Ohio	28
Connecticut	7	Oklahoma	5
District of Columbia	17	Oregon	5
Florida	9	Pennsylvania	59
Georgia	8	Rhode Island	3
Illinois	31	South Dakota	1
Indiana	9	Tennessee	8
Iowa	13	Texas	19
Kansas	3	Utah	1
Kentucky	4	Virginia	13
Louisiana	4	Washington	3
Maryland	9	West Virginia	2
Massachusetts	18	Wisconsin	12
Michigan	9		
Minnesota	21	Abroad	
Mississippi	2	Canada	18
Missouri	7	Other	25
Nebraska	2	Address Unknown	5

Membership outside of the United States, totaling 43 was distributed as follows: Canada, 18; Mexico, England, and Brazil, 3 each; Hawaii, Portugal, Puerto Rico, and Turkey, 2 each; Belgium, Cuba, Denmark, Australia, Greece, Malta, New Zealand, and Uruguay, 1 each.

At the time of rendering this report, the number of new applications pending was 31.

Richard Kovács, M.D., Chairman.

Ben L. Boynton, M.D.
Max K. Newman, M.D.
Clarence Dail, M.D.
George M. Piersol, M.D.

Awards by National Foundation for Infantile Paralysis

Awards totaling $1,441,721 for scientific research and professional education in poliomyelitis have been approved by the Board of Trustees of the National Foundation for Infantile Paralysis.

It was revealed that the $1,441,721 from March of Dimes contributions would go to 19 universities, institutions and professional organizations throughout the United States. The awards will support 34 individual projects for research aimed at preventing the disease and improving treatment methods, as well as for the training of doctors, scientists, nurses and other essential professional persons. The new awards went into effect July 1, 1950.

Awards for virus research, seeking a means to prevent or control the disease were made to:

Yale University, New Haven, Connecticut under the direction of Dr. John R. Paul, $161,750 and $90,638.
Johns Hopkins University, Baltimore, Maryland, under the direction of Dr. Kenneth F. Maxcy, $94,030.
University of Pittsburgh, Pittsburgh, Pennsylvania, under the direction of Dr. William McD. Hammon, $31,050.
University of Michigan, Ann Arbor, Michigan, under the direction of Dr. Thomas Francis, $81,500.
New York University-Bellevue Medical Center, New York City, under the direction of Dr. David P. Earle, Jr., $36,630.
University of Minnesota, Minneapolis, Minnesota, under the direction of Dr. Raymond N. Bieter, $14,000.
George Washington University, Washington, D. C., under the direction of Dr. Paul K. Smith, $7,120.
University of Minnesota, Minneapolis, Minnesota, under the direction of Dr. Jerome T. Syverton, $15,812.
University of Washington, Seattle, Washington, under the direction of Dr. Charles A. Evans, $26,930.
University of Oregon, Eugene, Oregon, under the direction of Dr. Arthur W. Frisch, $5,275.
University of California, Berkeley, California, under the direction of Dr. Wendell M. Stanley, $41,480.

For the purpose of improving treatment methods, thus reducing the damages caused by the disease, awards went to:

Cornell University Medical College, New York, New York, under the direction of Dr. David P. Barr, $4,700.
University of California, San Francisco, California, under the direction of Dr. Robert B. Aird, $4,900.
University of Minnesota, Minneapolis, Minnesota, under the direction of Dr. A. B. Baker, $15,125.
Northwestern University, Chicago, Illinois, under the direction of Dr. Lewis J. Pollock, $8,000.
The Children's Medical Center, Boston, Massachusetts, under the direction of Dr. William T. Green, $6,900.
University of California, San Francisco, California, under the direction of Dr. LeRoy C. Abbott, $9,100.
New York University, New York City, under the direction of Dr. Harold K. Work, $23,500.
Syracuse University, Syracuse, New York, undeg the direction of Dr. Otto H. Müller, $11,000.
University of Minnesota, Minneapolis, Minnesota, under the direction of Dr. Allan Hemingway, $4,404.

To meet the ever increasing need for professional persons to continue an expanding program of research and to provide the highest type of treatment to patients, educational awards were made to:

Meharry Medical College, Nashville, Tennessee, under the direction of Dr. Murray C. Brown, $70,800.
Washington University School of Medicine, St. Louis, Missouri, under the direction of Dr. Robert A. Moore, $13,400.
Northwestern University Medical School, Chicago, Illinois, under the direction of Dr. Stafford L. Osborne, $9,234.
University of Southern California, Los Angeles, California, under the direction of Miss Margaret S. Rood, $5,300.
American Physical Therapy Association, New York City, under the direction of Miss Mildred Elson, $53,762.
National Organization for Public Health Nursing, New York City, under the direction of Miss Anna Fillmore, $79,281.

The balance of the 14 educational awards will be administered by the National Foundation to provide scholarships and fellowships for graduate training in professional fields.

The Board of Trustees by interim action earlier in the year also approved an award of $150,000 to the American Hospital Association in Chicago for a two year study of the costs of hospital care. Also awarded at that time was $75,000 to the International Poliomyelitis Congress for its program of activities.

Cerebral Palsy Institute

A two week Institute in Cerebral Palsy, for qualified physicians, nurses, physical, occupational and speech therapists, social service and guidance workers, and teachers, has been announced by Dr. Philip D. Wilson, President of The Coordinating Council for Cerebral Palsy in New York City, Inc., 270 Park Avenue, New York City. The Institute will be held for a two week period beginning Monday, November 6, and will include lectures, clinical demonstrations and seminars.

An eminent faculty of physicians and professional personnel, authorities in their individual fields, will participate.

Following the Institute, opportunities for a three month in-service training course will be available to a limited number of physicians and therapists.

Further information can be obtained from Miss Marguerite Abbott, Executive Director of the Council, 270 Park Avenue, New York 17, N. Y.

Meetings

The Annual Convention of the National Society for Crippled Children and Adults will be held Oct. 26, 27 and 28, 1950, at the Stevens Hotel, Chicago.

Delegates from the more than 2,000 state and local affiliates of the National Society in the 48 states, District of Columbia, Alaska, Hawaii and Puerto Rico will come to Chicago to obtain up to date knowledge of National Society's three-point program of education, research and direct services.

The Fourth Pan-American Congress on Ophthalmology will meet in Mexico City from January 6th to 12th, 1952.

Refresher Course in Poliomyelitis

The Department of Physical Medicine, Northwestern University Medical School gave a refresher course in the care of infantile paralysis to qualified physical therapists and registered nurses from May 22 to June 23, 1950. The course was sponsored by the National Foundation for Infantile Paralysis.

Members of the Poliomyelitis Aid Unit and guest speakers participated in the teaching program. The Illinois State representative for the National Foundation for Infantile Paralysis assisted in arrangements and publicity for the course.

Two hour classes, consisting of lectures and demonstrations were held three evenings each week. The content of the course included epidemiology, otiology, pathology, neurology, the medical and orthopedic treatment, medical, social, educational aspects and home care. The emphasis was on the physical therapy and nursing care from the acute through the chronic stages.

The total enrollment of 175 was divided approximately into half physical therapists and half nurses representing many types of institutions and agencies in Chicago and surrounding area.

On July 5, 6, 7 a course for physicians in the treatment of Infantile Paralysis will be offered at Northwestern University Medical School. This course is also sponsored by the National Foundation for Infantile Paralysis.

BOOK REVIEWS

THE 1949 YEAR BOOK OF PHYSICAL MEDICINE AND REHABILITATION. (Including a Section on Occupational Therapy). (November, 1948-December, 1949). Edited by *Frank H. Krusen*, M.D., Professor of Physical Medicine, Mayo Foundation; Head of the Section on Physical Medicine, Mayo Clinic and *Howard A. Rusk*, M.D., Professor of Physical Medicine and Rehabilitation, New York University College of Medicine; Chairman of the Department of Physical Medicine, and Rehabilitation, Bellevue Hospital, New York City. Associated Editors, *Earl C. Elkins*, M.D., Consultant in Physical Medicine, Mayo Clinic; *Winfred Overholser*, M.D., Professor of Psychiatry, George Washington University School of Medicine; Superintendent, Saint Elizabeth's Hospital, Washington, D. C., and *George G. Deaver*, M.D., Professor of Clinical Rehabilitation and Physical Medicine, New York University College of Medicine; Director of the Department of Physical Medicine and Rehabilitation, Bellevue Hospital. Fabrikoid. Price, $5.00. Pp. 456, with illustrations. Year Book Publishers, Inc., 200 E. Illinois St., Chicago 11, 1950.

After a brief lapse, the Year Book of Physical Medicine continues annual publication with Rehabilitation added. The 1949 issue bids fair to maintain the editorial quality and careful selection of source material which were established by the former editor, Richard Kovács, M.D. The addition of rehabilitation opens up a wider field of selection in a rapidly growing specialty.

This volume is the first to be published under the new editorship. Since the new editors and associate editors have had wide experience, the book should not suffer a set back from lack of editorial experience. A review of the abstracted articles verifies this assumption. In the 1949 issue of the Year Book one will find abstracts of articles on research in physical medicine and rehabilitation, on the care of patients with poliomyelitis, on the treatment of paraplegia, cerebral palsy, amputations and tuberculosis. Speech defects and treatment are considered in several articles. The book indicates an increasing interest of physical medicine and rehabilitation in the fields of geriatrics, pediatrics, orthopedics, neurology, psychiatry and rheumatology. The Year Book (there are companion books in fourteen fields of medicine), is an excellent medium by which the physiatrist and the general practitioner can keep abreast with the advancements in physical medicine and rehabilitation.

A PRACTICE OF ORTHOPAEDIC SURGERY. By *T. P. McMurray*, C.B.E., M.B., M.CH., F.R.C.S. (Edin.), Professor of Orthopaedic Surgery, Liverpool University; Honorary Orthopaedic Surgeon, David Lewis Northern Hospital; Director of Orthopaedics, Royal Liverpool Children's Hospital; Consulting Orthopaedic Surgeon, Lancashire County Council; Visiting Orthopaedic Surgeon, Alder Hey Children's Hospital, Liverpool; Consulting Surgeon to the Ministry of Pensions Hospital; Regional Orthopaedic Consultant Ministry of Health, etc. Third edition. Cloth. Price, $8.00. Pp. 444, with illustrations. Williams & Wilkins Co., Mt. Royal and Guilford Aves., Baltimore 2, 1949.

The title of the volume might imply that surgery of the joints is the prime consideration and although the various operative procedures for the different diseases and disorders are included, no attempt is made to give the detailed surgical technics. For many of these conditions the author recommends and emphasizes the conservative measures rather than surgery, and physical therapeutic methods are suggested for practically all the diseases.

Tuberculosis of the individual joints is discussed more completely than other disabilities which in America would appear to be less important since during the past few years the tuberculous joints have become less frequent, fortunately. Most all conditions are very briefly considered — too sketchedly in some instances to be helpful, for example, the short chapters on anterior poliomyelitis, spastic paralysis and the various arthritides. This book would be helpful as a rapid review of orthopedic material for orthopedists chiefly.

PHYSIOLOGY OF HEAT REGULATION AND THE SCIENCE OF CLOTHING. Prepared at the Request of the Division of Medical Sciences, National Research Council. Edited by *L. H. Newburgh*, M.D., Professor of Clinical Investigation, The Medical School, University of Michigan. Cloth. Price, $7.50. Pp. 457 with 78 illustrations. W. B. Saunders Company, Philadelphia and London, 1949.

This book has grown out of the desire in World War II to provide adequate clothing for the fighting men so that they could fight under all circumstances and under all climates in a worldwide conflict. It is an excellent example of how a definitely practical and clinical problem can sponsor basic science research.

This book is far more than a description of adequate clothing under difficult circumstances. In fact, it has become a review of the physiology of heat regulation as it applies to clothing. To the specialist in Physical Medicine there is a wealth of material on body heat regulation in this book.

The first nine chapters of the book discuss the

human response to climatic environment. It includes chapters on Thermometry and Heat Transfer, an excellent chapter on the Regulation of Body Temperature by Dr. Bazett of the University of Pennsylvania and an equally good chapter on Physiological Adjustments to Heat by Dr. Robinson and Adjustments to Cold by Dr. Spealman. Of particular interest to the specialist in Physical Medicine is the article by Dr. Day on Regional Heat Loss.

There are extensive literature indexes in these chapters and together they form a review of physiology of heat regulation that should be read by everybody who is continuously concerned with the application of heat in clinical cases.

The second part of the book is concerned more directly with clothing as a thermal barrier. Here again the scientific aspects of the problem dominate the book. Some of these articles have been published in greater detail elsewhere, but the summary given here is of superior quality throughout.

Of particular interest to this reviewer were the reviews on the Physiology of the Desert by Dr. Adolph of the University of Rochester, and the article on Protection Against Dry Cold by Dr. Belding and Against Wet Cold by Dr. Spealman.

There is an article on the Special Problem of Hands by Drs. van Dilla, Day and Siple which should be read by everyone interested in peripheral vascular diseases.

Altogether the value of this book as a review and treatise on the physiology of heat regulation cannot be overestimated. It should be in the library of every specialist in Physical Medicine and every physical therapist.

THE PHARMACOLOGY AND TOXICOLOGY OF URANIUM COMPOUNDS. With a Section on the Pharmacology and Toxicology of Fluorine and Hydrogen Fluorine. Edited by *Carl Voegtlin*, Ph.D., Formerly Chief of Division of Pharmacology, National Institute of Health, U. S. Public Health Service; Formerly Director of Cancer Research and Chief of the National Cancer Institute, and *Harold C. Hodge*, Ph.D., Professor of Pharmacology and Toxicology, School of Medicine and Dentistry, University of Rochester. Cloth. Price, $10.00. Tome A*. Pp. 524 with 10.30 illustrations; Tome B**. Pp. 1084 with 17.11 illustrations. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 18, 1949.

The item here reviewed consists of two books, tomes, or volumes both marked "VI-1" meaning "Volume 1 of Section VI" of the National Nuclear Energy Series. They are distinguishable externally by the fact that one is marked with one star, the other with two stars. The former contains the table of contents, the first nine chapters and part of the tenth, making 524 pages; the second contains the rest of the tenth chapter, the remaining seven chapters, and the index, and the pages are numbered from 525 to 1084. It is unfortunately necessary to make this clear because there is a source of annoyance here similar to that in the famous Abderhalden series of Bånder, Teile, Abteilungen and Hefte, and it is clear that the editors have not hit upon the best possible solution of their problem.

The subject matter of these two tomes is extremely important and timely inasmuch as uranium is stated to be the most poisonous of metals when injected intravenously or subcutaneously in soluble forms. A compact summary of its toxicology begins on p. 237. The fact that so much of the processing of uranium involves the handling of large quantities of the volatile and extremely reactive hexafluoride adds to the difficulty of avoiding industrial accidents. This also leads to the necessity of considering the chemistry, toxicology and technology of fluorine, hydrofluoric acid, and the fluorides, about which the present work also supplies information of fundamental importance. The whole makes actually dramatic reading, and the numerous contributors all reserve recognition as collaborators in a scientific achievement of the highest order.

ULCERS AND ECZEMA OF THE LEG SEQUELES OF PHLEBITIS. By *Holger Bisgaard*. Preface by H. Haxthausen, M.D., Professor of the University of Copenhagen. Paper. Pp. 111 with 36 illustrations. 15 Danish Kroner. Einar Munksgaard, Norregade 8, Copenhagen, Denmark, 1948.

This is a monograph originally published in 1939 and recently translated into English and published by the author's widow. The author in his explanation for many of the common disorders of the lower extremities states that these are the result of "infiltration edema" which involves the skin, subcutaneous tissues, muscles, nerves and even the bone. This work reports 100 cases of varying degrees and stages. The author's treatment for these "varicose syndrome" of the leg includes a special technic of massage, elastic bandaging applied according to certain rules and ambulation. He believes heat exaggerates the infiltration and that bakers, blacksmiths and women who do much cooking are made worse by exposure to the radiation. Although the principles in the method of treatment are not new, they are not as frequently used as the reported excellent results in this monograph would justify.

MENTAL HYGIENE IN PUBLIC HEALTH. By *Paul V. Lemkau*, M.D., Associate Professor of Public Health Administration and Director, Mental Hygiene Study, School of Hygiene and Public Health, The Johns Hopkins University. First Edition. Cloth. Price $4.50. Pp. 396. The McGraw-Hill Book Company, 330 West 42nd Street, New York 18, N. Y. 1949.

The author of this volume has had considerable experience in field research in preventive psychiatry as well as in the service in the U. S. Army. He offers a practical approach to discussion of the elements of mental hygiene in an over-all program of public health and preventive medicine. Part I undertakes to define the fields of mental hygiene and public health; it outlines public health practices in relation to mental hygiene, and indicates the responsibility of the health officer for this part of public

health service. Part II discusses personality development and maturation of the individual with the clarity and simplicity essential to an understanding of principles by the reader who lacks specialized training in psychiatry. This volume should do much to broaden the concept of the need and practicability of establishing mental hygiene service as a component of modern public health practice. It should be also of great value both as a reference and as a text in many types of educational institutions, from colleges of liberal arts to medical schools and other graduate institutions.

BRIEF PSYCHOTHERAPY. A HANDBOOK FOR PHYSICIANS ON THE ASPECTS OF NEUROSIS. By *Bertrand S. Frohman*, M.D., with the collaboration of *Evelyn P. Frohman*. Foreword by *Walter C. Alvarez* M.D. Cloth. Price, $4.00. Pp. 265. Lea & Febiger, 600 S. Washington Sq., Philadelphia 6, Pa., 1948.

This is a practical handbook on neurosis for the general practitioner. It presents a classification of neuroses followed by a chapter on neurotic mechanisms. The material on etiology is concise and leaves out the more abstract theories. Active psychotherapy is described and pertinent warning is given that "frank neurotic states are best left untouched by inexperienced hands." The use of illustrative case histories adds interest to the material. Included are fourteen pages on general semantics as used in psychotherapy. An interesting feature is the glossary for patients at the end of the book. Within the 265 pages of the text is compressed considerable helpful information for the physician interested in psychosomatic medicine.

ESSENTIALS OF OBSTETRICAL AND GYNECOLOGICAL PATHOLOGY. By *Robert L. Faulkner*, M.D., F.A.C.S., Assistant Professor Gynecology, The Western Reserve Medical School; Associate Gynecologist, University Hospitals of Cleveland, Ohio, and *Marion Douglass*, M.D., Formerly Assistant Professor, Gynecology, The Western Reserve Medical School. Second edition. Cloth. Price, $8.75. Pp. 357 with 300 illustrations. C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, 1949.

This is a textbook on obstetrical and gynecological pathology which compiles handily the scattered pathological information to be found in clinical textbooks. The female generative organs are unique in so far as there are so many normal physiological variations in histology. Even minor disturbances in the complicated endocrine mechanism governing their functions may bring about profound changes in these structures. The frequency of inflammatory processes and tumors of many kinds in the female pelvis is well known. All these facts amply justify the publication of a volume limited to this particular field of pathology. The favorable reception of the first edition has warranted the second edition in which some of the original sections presenting systematically the structure and pathology of the various parts of the female genital tract have been amplified and a large number of new illustrations have been added. This well presented volume should be useful for students, interns and all physicians concerned in the special pathology related to obstetrics and gynecology.

INJURIES OF THE BRAIN AND SPINAL CORD AND THEIR COVERINGS. NEUROPSYCHIATRIC, SURGICAL, AND MEDICO-LEGAL ASPECTS. Edited by *Samuel Brock*, M.D., Professor of Neurology, New York University College of Medicine. Third edition. Cloth. Pp. 783. Price, $10.00. The Williams & Wilkins Company, Mt. Royal and Guilford Avenues, Baltimore 2, 1949.

The subject of trauma to the central nervous system is of growing importance particularly in view of our mounting toll of traffic injuries. This new edition is also appropriate at this time as it includes new information gained from war experience. New chapters are devoted to discussion of intervertebral disc lesions, back and cord injuries, traumatic neuroses, and electric shock injuries. Dr. Brock has selected an imposing list of contributors with the result that authoritative monographs are available on all aspects of brain and spinal cord trauma and the separate chapters are well documented by carefully chosen references. Differential diagnosis, pathology and physiology are stressed rather than treatment details. Important medico-legal aspects are covered, but not rehabilitation of the injured.

This is a book which should prove indispensable to the neurosurgeon and considered as a standard reference for all others dealing with accident cases of this type.

PRACTICAL NEUROLOGICAL DIAGNOSIS. WITH SPECIAL REFERENCE TO THE PROBLEMS OF NEUROSURGERY. By *R. Glen Spurling*, M.D., Clinical Professor of Surgery (Neurosurgery), University of Louisville School of Medicine, Louisville, Kentucky. Fourth edition. Cloth. Pp. 268. Price, $5.00. Charles C Thomas, Publisher, 301-327 East Lawrence Avenue, Springfield, Illinois, 1950.

This book, the fourth edition of Practical Neurological Diagnosis, has been completely rewritten with the addition of a section on the hypothalamus. A glossary of commonly used neurological terms has also been added. Chapter One deals with neurological examination, with pertinent facts regarding the taking of an adequate history. Chapters Two to Five cover the divisions of the Central Nervous System, presenting in a direct, concise manner the present concepts of anatomy, physiology and clinical considerations pertinent to each. Chapter Six deals with examination of the reflexes; Chapter Seven the cerebrospinal fluid; Chapter Eight diagnostic roentgenology. This volume is well written and outlined, presenting the principles of neurological diagnosis simply and directly, with adequate illustrations. It is recommended for students and neurosurgeons as an aid in diagnosis of neurological conditions, but does not take the place of a neurological textbook.

TEXTBOOK OF PHYSIOLOGY. By *William D. Zoethout*, Ph.D., Professor Emeritus of Physiology in the Chicago College of Dental Surgery (Loyola University), and *W. W. Tuttle*, Ph.D., Professor of Physiology, College of Medicine, State University of Iowa. Tenth edition. Cloth. Price, $4.75. Pp. 710 with 307 illustrations. The C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, 1949.

The advances made in physiology necessitated an extensive revision of this popular textbook. In the presentation of the subject matter the authors have realized the limited knowledge of the beginner and have devoted adequate space to the anatomic and chemical relationships associated with basic physiologic concepts. In addition, they have taken a practical view of the many principles.

It is true that much may have been left unsaid, for physiology today is too vast a subject to be treated in a comprehensive manner. The book, however, is well suited to the needs of the college student or physical therapist who desires an elementary knowledge of the subject. As a whole, it is well written, containing many definitions together with a well designed glossary. There are a sufficient number of good illustrations and a selected list of references. As a textbook of physiology, it can be recommended to physical therapists.

THEY ALSO BELIEVE. A STUDY OF MODERN AMERICAN CULTS AND MINORITY RELIGIOUS MOVEMENTS. By *Charles Samuel Braden*, Ph.D., Professor of the History and Literature of Religions, Northwestern University. Cloth. Price, $6.00. Pp. 491. The Macmillan Company, 60 5th Ave., New York 11, 1949.

The author presents a sympathetic study of thirteen minority religious groups, all either born on American soil or having their major development here. By far the greater bulk of the writing concerning the separate movements has been violently partisan, either for or against. The author attempts to do eight things: (1) to present the essential historical facts concerning the rise and development of each group considered; (2) to set forth as simply and clearly as possible the major distinctive religious ideas each holds, and out of what these ideas arose; (3) to show at what points each agrees with and differs from normative Protestant or Catholic belief; (4) to describe and account for the distinctive form of organization employed in each. (5) to indicate the significant religious, social, economic, or other practices exhibited by each group; (6) to point out what seems to be the basic motivations to which each dominantly appeals; (7) to note current trends in the present day life and thought of the various movements; and finally (8) to make some attempt at generalizations concerning the movements on the basis of comparison of one with another and with the majority religious groups. The author makes no attempt to evaluate the movements, to show where they are right or wrong, strong or weak. This is left for the reader to do.

Some of the most important chapters are: the peace mission movement of Father Divine; psychiana. new thought; unity school of Christianity; Christian Science, theosophy; the I am movement; the liberal Catholic Church; spiritualism; Jehovah's Witnesses; Anglo-Israel; the Oxford Group movement; and Mormanism.

The author has been a life long Methodist, is an ordained clergyman, who has been a university teacher in the field of the History of Religion for many years. The book is ably written and the subject matter well presented. Dr. Braden has performed a great service in presenting this interesting and unbiased study.

THE PRACTICE OF MEDICINE. By *Jonathan Campbell Meakin*, C.B.E., M.D., LL.D., D.S. Formerly Professor of Medicine and Director of the Department of Medicine, McGill University; Formerly Physician-in-Chief, Royal Victoria Hospital, Montreal; Formerly Professor of Therapeutics and Clinical Medicine, University of Edinburgh; Fellow of the Royal Society of Edinburgh; Fellow of the Royal Society of Canada; Fellow of the Royal College of Physicians, Edinburgh; Honorary Fellow of the Royal College of Surgeons, Edinburgh; Fellow of the Royal College of Physicians, Canada; Fellow of the American College of Physicians; Honorary Fellow of the Royal Society of Medicine. Fifth edition. Cloth. Price, $13.50. Pp. 1558, with 518 illustrations. The C. V. Mosby Company, 3207 Washington Blvd., St. Louis 3, 1950.

A book of this magnitude purporting to cover the enormous subject of the practice of medicine has found its rightful place in medical literature as a text for medical students and a reference for general practitioners. One cannot expect all the newer advances to be included, but established recent therapeutic methods are described. Notable in this revision is a new chapter on psychosomatic medicine replacing the one on psychiatry. Chemotherapy and the use of antibiotics are also the subjects of a new chapter, and the chapter on endocrines is largely rewritten. As is true of all publications of this type with which the reviewer is familiar, the topic of physical medicine and rehabilitation is inadequately presented. The illustrations are of good quality, and the indexing and printing are designed to enhance speedy reference reading.

PHYSICAL MEDICINE ABSTRACTS

Disablement.

Edit. — Brit. J. Phys. Med. **12**:85 (July-Aug.) 1949.

Adverse outside factors beyond the control of the disabled are, erroneous vocational guidance; employment in unsuitable jobs, especially inferior jobs, and unsatisfactory management at their place of employment. With a few exceptions, in a group studied by Wittkower, all the patients who had had amputations were in employment at the time of examination. A high proportion of men who had been skilled manual workers changed over to clerical occupations after their disablement. Their tendency to give up their skilled jobs was generally not warranted by the type of their disability. Roughly 50 per cent of the men who had lost a leg were in occupations which required long standing (for example, fitters, welders and assemblers), or walking and car-driving (for example, factory inspectors, salesmen, and roundsmen)), or even heavy lifting (for example, stokers and railway porters). About 33 per cent of those who had lost an arm were in occupations which required great manual skill, for example, as fitters and welders. About 66 per cent of the maimed were satisfied with their employment. Those who were dissatisfied complained that their occupations were too strenuous, were only temporary, were too monotonous, or did not give them enough scope or chance of promotion.

The Short First Metatarsal: Its Incidence and Clinical Significance. Robert I. Harris, and Thomas Beath.

J. Bone & Joint Surg. **31-A**:553 (July) 1949.

Measurable shortness of the first metatarsal relative to the second does not necessarily mean that it cannot as readily reach the ground and that less weight will be transmitted through this bone. The obliquity of the metatarsals in relation to the ground means that all can share equally in weight-bearing, provided the longer metatarsals are on a higher plane than the shorter. This normally will be the case if the metatarsal arch exists. It is then possible for the second and third metatarsals to extend farther forward than the first before reaching the ground, because they are at the apex of the metatarsal arch. In any case, the efficient use of the foot to support the weight of the body and to propel it in walking and running is not entirely dependent upon perfection of structure, even though this is of importance. In feet which are not perfect in their structure, compensatory mechanisms of considerable efficiency develop, which tend to offset the ill effects that might arise as the result of deviation from standard structure. In the case of the first metatarsal segment, the flexor hallucis longus, as has already been indicated, can provide the necessary supplement to function. After all, foot function is dynamic as well as static.

Venous Thrombo-Embolic Phenomena: Their Absence in Paraplegic and Tetraplegic Patients. Albert W. Cook, and Harold A. Lyons.

Am. J. M. Sc. **218**:155 (Aug.) 1949.

The observation is made that a group of 45 paralyzed veterans represent a total of 115 man-years in which their lower extremities have not been moved voluntarily. They have been subjected to approximately 175 surgical procedures. Up to the present there has been no death in this group from a pulmonary embolus. Data concerning the coagulation mechanism of the blood of these patients are presented and shown not to be consistent with the idea that the blood of these patients clots subnormally. Other factors producing injury to the vein walls in the lower extremities and favoring venous stasis in these limbs are reviewed. From the data obtained the following conclusions are warranted: the young average age of the patient in this group accounts for the absence of fatal pulmonary embolizations, the age of bed-rest patients is one of the chief determinants of the occurrence of lethal thrombo-embolic phenomena, and the basis for the influence of advancing age on the incidence of thrombo-embolisms may be, in part, the concomitant decrease in the human source of heparin, the mast cells.

The Study of Peripheral Vascular Disease with Radioactive Isotopes: Part II. F. W. Cooper, Jr.; Daniel C. Elkin; Patrick C. Shea, Jr., and E. W. Dennis.

Surg., Gynec. & Obst. **88**:711 (June) 1949.

The introduction of the use of radioactive isotopes in the study of peripheral vascular disease has made possible the critical evaluation of the circulation in the tissues of the extremities. Although all methods of instrumental investigation have certain inherent weaknesses, they contribute a valuable addition to the clinical evaluation of vascular disorders. Studies on the circulation in the muscles of the extremities in normal individuals and those with vascular diseases have made possible a more objective evaluation of the patient. By measuring the rate of disappearance of radioactive sodium chloride from the muscles of an extremity, an additional method of evaluating the circulatory physiology of the extremities has been made possible. In the study of 57 normal individuals and 102 patients with peripheral vascular disturbances, curves representing the rate of

disappearance of the sodium from the muscle form statistically accurate patterns. It is believed that this method of study may offer a valuable aid in the evaluation of certain forms of therapy which are believed to enhance the circulation.

Care of the Paraplegic.

Current Comment. — J. A. M. A. **140**:1032 (July 23) 1949.

The Journal, during the last two weeks, has published an extended consideration of the care of the paraplegic patient. The National Paraplegic Foundation, which is concerning itself particularly with veterans who have suffered from these seriously disabling injuries, sponsored the article through its medical advisory committee. Among the agencies that have been concerning themselves particularly with the paraplegic patient is the 52 Associations, Inc., organized with the specific purpose of doing everything possible to make life worthwhile for the veteran who has become disabled through injuries to the spine that make the lower half of the body incompetent. Any physician who reads the intensive detail involved in the scientific care of such patients will realize that laymen who devote their time, their funds and their efforts to bringing some happiness into the lives of those who have given of themselves so fully toward the winning of the war deserve the utmost encouragement and assistance. The 52 Associations deserve support, particularly by physicians who know how important is the mental attitude of the disabled patient.

The Management of Recovery from Venous Thrombosis in the Lower Limbs. John Homans.

Surgery **26**:8 (July) 1949.

This report is based upon a study of 55 cases exhibiting the quiet stage of venous thrombosis, or phlebothrombosis in the lower limbs. It was hoped to learn how the management of the immediate and remote convalescence had influenced the ultimate state of the affected leg or legs. A few patients were treated by conservative measures alone, most were subjected to some form of vein interruption, and a smaller number to anticoagulant therapy. Though many of these patients had suffered from pulmonary embolism, no attempt is made here to determine the relative life-saving value of the various procedures, the ultimate fate of the leg being the only consideration. Well-developed obstructive thrombophlebitis is not included. The author has previously discussed the late results of this disease. Experience with cases of early quiet thrombosis (phlebothrombosis) treated by vein interruption or by anticoagulation indicates that: The consistent use of gravity drainage, graded exercises, bandaging, and the proper balance between dependency and elevation is of advantage in establishing a permanently efficient collateral venous return from the lower limbs, and is especially required after an extensive thrombosis; the connections of the deep (profunda) with the superficial femoral vein usually are intimate and occasionally the two systems are practically one, but the combined systems have unsatisfactory collateral connections with higher veins; the normal deep femoral system of veins may be expected to offer a good collateral pathway as long as the common femoral vein is open, whether or not the common femoral has been invaded by thrombosis, and surgical obstruction of the common femoral vein necessarily and seriously opposes the establishment of an effective collateral circulation, but may be compensated for by especially prolonged physical therapy measures during the immediate and remote convalescence.

Exercise in the Bath: Evidence of Its Value as Compared with Exercise in Air. A. R. Togna.

Brit. J. Phys. Med. **12**:105 (July-Aug.) 1949.

The method of exercise in water offers the ideal solution to the problem of breaking through the vicious circle of growing decadence, by enabling everyone to make better use of the oxygen in the air breathed. By exercising the body in the bath, even very weak persons are enabled to take exercise which helps to restore, as far as possible, their bodily energy. This will become obvious when the nature of the gymnastics is considered. Each exercise takes the form of a rhythmic movement, designed to bring every muscle of the body into concerted action and the body as a whole into a state of balanced activity; but, unlike other forms of activity, the bath movements are not strenuous. One is amazed to find that, even when they are performed vigorously, the pulse rate goes up by only a few beats. This is due to the nature of the exercises and to the fact that the buoyancy of the water almost entirely overcomes the force of gravity. The specific gravity of water is about the same as that of the body. In other words, the natural weight of the latter, or any part of it, is reduced to a minimum, the body being largely sustained by the water. The object of performing the exercises in water is to counteract the gradual loss of elasticity by relieving the muscle of the tension necessary to support the weight of the body in air. By means of the fuller muscular relaxation so obtained, the three essential properties of muscle, namely, extensibility, retractility, elasticity, are provided with an economical action, capable of delaying the loss of muscular tone. The bather can find an indication of the valuable result obtained in his own case by taking his pulse rate before and immediately after exercise. He will find that his pulse rate is only increased by a few beats, however long the exercise has been continued, whereas, by attempting the same muscular movements in air, he will find himself exhausted within a minute or two, however young and healthy he may be.

As a result of the general circulation promoted by the system of exercise in the bath, oxygen and nourishment are more evenly carried to, and shared by, the tissues, through the maximum expansion of the lungs and consequent contraction and relaxation of the abdomen. In harmony with

this action the blood in the big vessels of the abdomen, as noted above, is squeezed out and pumped into them again rhythmically. Congestion of the abdominal organs is prevented or relieved. The normal functions of the liver, pancreas, genitalia and endocrine glands are preserved. The warmth of the surrounding water causes the capillaries of the skin to open, with the result that the skin becomes better nourished and more useful in quality, and the cleansing which takes place through its active pores assists the work of the kidneys.

Physical Therapy in Postthoracoplasty. One Year's Notes and Observations. Jacob Goldberg; Ralph Friedlander; Harry B. Doppelt, and Dorothy E. Miller.

Am. Rev. Tuberc. 60:189 (Aug.) 1949.

Sixty postthoracoplasty patients were observed during a one year time in a Veterans Hospital for tuberculous patients. The observable changes which resulted from thoracoplasty were classified under two headings: (a) scoliosis with concomitant skeletal changes of the head and neck, the shoulder girdle on the operated side, and thorax, and the pelvis; (b) skeletal deviations and changes of muscle function of the shoulder girdle on the operated side.

An attempt was made to explain the differences in external appearance resulting from thoracoplasty on the basis of six factors; exercise program; age of patient; nature of surgery; condition of spine prior to surgery; morphologic type; and personality.

The Pathology and Treatment of the Post-Phlebitic Leg and Its Complications. Josephus C. Luke.

Canad. M. A. J. 61:270 (Sept.) 1949.

The author lists instructions for the continual care of the leg damaged by phlebitis as follows: Wear your elastic stockings from the time you get out of bed until you retire, with the exception of bath time. The stocking should be renewed every three months, and it is best to have two stockings that can be alternated for cleaning purposes. Do not stand for more than thirty minutes without sitting down for fifteen minutes and elevating the leg on another chair. When standing, get into the habit of flexing the toes in your shoes and frequently rising on tip toes. Plan your day so that you can lie down for two to three half hour periods and elevate your leg to a 45 degree angle. The back of a small straight backed chair is useful for this purpose. Whenever you sit down, elevate your leg on a footstool, chair or chesterfield. At night raise the foot of the bed on blocks about twelve inches high. Apply a bland cold cream to the affected skin at nights about every second day. Avoid irritation to the involved leg, especially in respect to sunburn and hot water bottles. Be extremely careful to prevent bumping or scratching the affected leg.

The etiology of the post-phlebitic leg and its complications is discussed and the belief expressed that interference of the lymphatic return is the greatest single factor and venous retardation a secondary one. The entrance of pyogenic organisms via superficial trauma in such a leg is the immediate cause of the complications.

An attempt has been made to group such cases into four types for the purpose of treatment. These are associated secondary incompetent varicose veins, those with evidence of sympathetic over-activity in the leg, those with marked soft tissue sclerosis about the ulcer and finally the group where the above factors are not present. Emphasis is laid on the point that these forms of therapy are only aids in healing of the complications, giving also some measure of protection against recurrence.

Poliomyelitis in the Arctic. J. D. Adamson; J. P. Moody; A. F. W. Peart; R. A. Smillie; J. C. Wilt, and W. J. Wood.

Canad. M. A. J. 61:339 (Oct.) 1949.

A widespread epidemic of acute poliomyelitis is described among Eskimos in the Eastern Arctic of Canada. This is one of the coldest regions of the Arctic. The epidemic occurred in the depth of an unusually severe winter. It resulted in unprecedented devastation; in the Chesterfield area it killed over 5 per cent of the total population and paralyzed 14 per cent. Spread appears to have been largely through the medium of clinically healthy carriers. All ages except those under three were affected. No evidence of disease was found in children under three years of age and there were only two at the ages of three and four. This suggests an absence of immunity except in the first few years. The epidemic has been shown by monkey inoculation to be due to a poliomyelitis virus. The brunt of disease from clinical signs and from pathologic findings is shown to have fallen on the lower cord, whence it ascended to involve the respiratory muscles. Very little evidence of meningeal, bulbar or cerebral involvement was found. All the features of the epidemic suggest that in a non-immune community poliomyelitis behaves like any acute infectious fever.

The Physical Therapy Department. Leigh T. Wedlick.

Brit. J. Phys. Med. 13:57 (March) 1950.

The physical therapy department should not be an isolated department; it is a vital link in the chain of hospital treatment, and it impinges not only on general medicine and surgery, but on all the specialties

In the establishment of a physical therapy department the author considers that the first essential is the appointment of a medical director. The technicians who administer the actual treatments should be fully trained physical therapists, working under the direction and close supervision of the medical director. The use of semi-trained technicians, or of nurses who are not fully acquainted with the technical side of the work, can only lead to bad results.

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Menominee 1
Munising 1
Muskegon 3
Muskegon Hts. 1
Niles 1
Oak Park 1
Okemos 1
Petoskey 1
Pontiac 2
Port Huron 1
Pullman 1
River Rouge 1
Romeo 1
Saginaw 4
St. Joseph 1
Temperance 1
Traverse City 3
Whitehall 1
Willow Run Village 2
Wyandotte 1
Ypsilanti 1

Minnesota

Altura 1
Arlington 1
Austin 1
Brewster 1
Buffalo 1
Buhl 1
Calumet 1
Chisholm 2
Cloquet 1
Dawson 1
Deer River 1
Dodge Center 1
Duluth 6
Faribault 1
Farmington 1
Halstead 1
Hibbing 2
Kasson 1
Litchfield 1
Luverne 1
Madelia 1
Manchester 1
Minneapolis 56
Nashwauk 1
Osseo 1
Proctor 1
Red Wing 1
Rochester 31
Savage 1
Spring Valley 1
St. Cloud 3
St. Louis Park 1
St. Paul 28
Stillwater 1
Waseca 1

Mississippi

Biloxi 1
Brandon 1
Gulfport 1
Hattiesburg 1
Holly Springs 1
Jackson 2
Natchez 1
Pontotoc 1
Vicksburg 3

Missouri

Brentwood 1
California 1
Clayton 1
Columbia 3
Excelsior Springs 2
Harris 1
Independence 1
Kansas City 23
Kirkwood 3
La Grange 1
Liberty 1
Maplewood 2
Normandy 1
Overland 1
Potosi 1
Rockhill 1
St. Louis 27
University City 1
Vanduser 1
Webster Groves 2
Wellsville 1

Montana

Billings 3
Bozeman 2
Bridger 1
Butte 1
Ft. Harrison 1
Great Falls 1
Helena 3
Lewistown 3
Missoula 5
Polytechnic 1
Twin Bridges 1

Nebraska

Fairbury 1
Fremont 1
Grand Island 1
Hastings 1
Kearney 1
Lincoln 5
North Platte 1
O'Neill 1
Omaha 7
Scottsbluff 2
Stanton 1

Nevada

Carson City 1
Reno 1

New Hampshire

Alton Bay 1
Belmont 1
Center Barnstead 1
Concord 1
Dover 1
Durham 1
Gloversville 1
Hampstead 1
Hanover 2
Hollis 1
Keene 2
Lebanon 1
Lisbon 1
Manchester 4
Nashua 1
Newport 2
Penacook 2
Portsmouth 1
Westmoreland Depot 1

New Jersey

Arlington 1
Atlantic City 2
Bayonne 1
Bayville 1
Beachwood 1
Belleville 1
Bloomfield 3
Boonton 1
Bridgeton 1
Camden 3
Camp Kilmer 1
Clifton 3
Closter 1
Collingswood 1
Cranford 1
Cresskill 1
Denville 1
Dover 1
Dumont 1
East Orange 4
East Paterson 2
Elizabeth 2
Englewood 2
Essex Falls 1
Fair Lawn 1
Far Hills 3
Florham Park 1
Fords 1
Fort Dix 1
Fort Monmouth 1
Frenchtown 1
Greystone Park 1
Haddonfield 1
Hawthorne 1
Hopatcong 1
Irvington 1
Jersey City 5
Kearny 1
Linden 1
Linwood 1
Long Branch 1
Longport 3
Lyons 1
Madison 1
Maplewood 1
Matawan 1
Monroeville 1
Montclair 3
Moorestown 1
Morris Plains 1
Newark 15
New Brunswick 3
Neptune 1
Newton 1
North Bergen 1
North Brunswick 1
Nutley 1
Oaklyn 1
Park Ridge 1
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Rahway 1
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Ridgefield 1
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South Orange 1
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Woodridge 1
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New Mexico

Alamogordo 1
Albuquerque 9
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Nara Visa 1
Oil Center 1
State College 1
Taos 1

New York

Albany 8
Albion 1
Amsterdam 1
Astoria 2
Auburn 1
Babylon 1
Baldwin 1
Baldwinsville 1
Batavia 1
Bath 1
Bay Shore 1
Bayside 4
Beacon 1
Big Moose 1
Binghampton 2
Booneville 1
Brockport 1
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Bronxville 2
Brooklyn 71
Buffalo 24
Burnt Hills 1
Byron 1
Canandaigua 1
Carmel 1
Castle Point 2
Catskill 1
Chappaqua 2
Chatham 1
Chazy 1
Clifton Springs 1
Clyde 2
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Cooperstown 1
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Cortland 2
Croton-on-Hudson 1
Delhi 1
Dundee 1
Dunkirk 1
East Islip 1
East Syracuse 1
Elmsford 1
Fairport 1
Falconer 2
Farmingdale 1
Fayetteville 1
Flushing 8
Forest Hills 4
Franklyn Sq. 1
Fredonia 1
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Fulton 2
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Geneseo 1
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Granville 1
Great Neck 1
Halesite 1
Harpersfield 1

Hastings-on-Hudson 2
Helmuth 1
Hicksville 2
Highland Falls 1
Holland 1
Hollis 1
Hornell 1
Howes Cave 1
Hudson Falls 1
Huntington 2
Irvington-on-Hudson 1
Ithaca 5
Jackson Hts. 2
Jamaica 2
Jamestown 1
Johnson City 1
Kenmore 1
Kew Gardens 2
Lackawanna 1
Le Roy 2
Levittown 2
Lewistown 1
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Lynbrook 1
Mamaroneck 2
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Middletown 1
Mitchell AFB 1
Monroe 2
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Mount Kisco 3
Mount Vernon 4
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New Paltz 1
New Rochelle 4
New York 128
Niagara Falls 5
North Lawrence 1
Northport 1
North Syracuse 1
North Tonawanda 1
Norwich 1
Oneonta 1
Orangeburg 3
Ossining 1
Ozone Park 1
Painted Post 1
Patchogue 1
Pearl River 1
Pelham 1
Pelham Manor 1
Perry 1
Peru 1
Pleasant Valley 1
Pleasantville 1
Point Pleasant 1
Port Chester 1
Port Jefferson 6
Poughkeepsie 3
Queens Village 1
Rego Park 1
Richmond 1
Richmond Hill 3
Ridgewood 1
Rochester 22
Rockville Centre 1
Roslyn Hts. 1
Rye 1
Saint Albans 1
Saint James 1
Saranac Lake 1
Saratoga Springs 1
Sayville 1
Scarsdale 2
Schenectady 11
Snyder 2
Southampton 1
South Nyack 1
Springfield Gardens 1
Spring Valley 2
Stapleton 2
Staten Island 8
Sunmount 1
Sunnyside 1
Syosset 1
Syracuse 8
Tarrytown 1
Troy 2
Trumansburg 1
Utica 4
Valhalla 1
Varysburg 1
Walden 1
Walton 1
Wappingers Falls 1
Warsaw 1
Westbury 1
West Haverstraw 11
West Point 1
White Plains 4
Williamsville 3
Williston Park 1
Woodside 3
Yonkers 1

North Carolina

Asheville 5
Black Mountain 1
Camp Le Jeune 1
Candor 1
Charlotte 9
Cleveland 1
Durham 9
Fayetteville 1
Fort Bragg 3
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Louisburg 1
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Oteen 1
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Wingate 1
Winston-Salem 1

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Argusville 1
Clyde 1
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Hunter 1
Jamestown 2
Minot 3

Ohio

Akron 6
Alexandria 1
Alliance 2
Amherst 1
Ashtabula 2
Aurora 1
Barberton 1
Barnesville 1
Bedford 1
Bowling Green 2
Brecksville 1
Canal Winchester 1
Canton 2
Chardon 1
Chillicothe 1
Cincinnati 17
Cleveland 40
Cleveland Hts. 4
Columbiana 1
Columbus 14
Conneaut 1
Dayton 17
Delaware 1
East Cleveland 1
East Liverpool 1
Elyria 1
Empire 1
Euclid 1
Findlay 1
Glendale 1
Greenfield 1
Greenville 1
Jackson 1
Lakewood 7
Lima 1
Lorain 1
Macedonia 1
Mansfield 1
Maple Hts. 3
Middletown 1
Mount Vernon 1
Negley 1
Newark 1
New London 1
North Canton 1
Northridge 1
Norwood 4
Painesville 1
Rocky River 1
Salem 2
South Euclid 1
Springfield 5
Steubenville 2
Terrace Park 1
Toledo 8
University Hts. 1
Vandalia 1
Walbridge 1
Waldo 1

Walnutcreek 1
Warren 2
Westerville 1
Worthington 1
Youngstown 5
Zanesville 1

Oklahoma

Bartlesville 1
Edmond 1
Enid 1
Ft. Sill 1
Lawton 1
Miami 1
Muskogee 2
Norman 2
Oklahoma City 9
Ponca City 1
Tahlequah 1
Tulsa 9

Oregon

Albany 1
Brockway 1
Camp White 1
Corvallis 2
Cottage Grove 1
Eugene 9
Nehalem 1
Oak Grove 1
Oswego 1
Pendleton 1
Portland 37
Roseburg 3
Salem 3
Tigard 1
Tillamook 1
Troutdale 1
Willamina 1

Pennsylvania

Aldon 1
Aliquippa 1
Allentown 3
Ambridge 1
Ardmore 2
Aspinwall 2
Bath 1
Beaver 2
Beaver Falls 1
Berwick 1
Berwyn R. D. 1
Bethlehem 2
Blairsville 1
Bloomsburg 2
Bovard 1
Bradford 1
Bridgeville 1
Broomall 1
Bryn Mawr 1
Butler 3
Camp Hill 1
Canansburg 1
Carlisle 1
Carnegie 1
Charleroi 1
Chester 1
Clinton County 1
Coatesville 1
Conneautville 1
Connelsville 2
Coraopolis 1
Crabtree 1
Dalton 1
Danville 1
Delaware City 1
Delaware Water Gap 1
Doylestown R. D. 1
Drexel Hill 1
East Greenville 1
Easton 1
East Pittsburgh 1
Elizabethtown 3
Elkins Park 1
Erie 3
Erie County 1
Evans City 1
Everett 1
Frackville 1
Fullerton 1
Gettysburg ? 1
Girard 1
Greencastle 1
Harrisburg 3
Hatboro 1
Havertown 2
Hawley 1
Hazleton 3
Hellertown 1
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Jermyn 1
Johnstown 6
Kane 1
Karns City 1
Kennet Sq. 1
Kittaning 2
Lancaster 3
Lansdowne 3
Latrobe 1
Lawrence City 1
Lebanon 3
Leetsdale 1
Lewisburg 1
Linwood 1
Lumberville 1
Luzerne 1
Manheim 1
Mars 1
McAdoo 1
Meadville 1
Mercer 1
Meyersdale 1
Milford 1
Milton 1
Montoursville 1
Mount Penn 1
Muncy 1
New Castle 1
New Kensington 2
Newton Square 1
Nicholson 1
Norristown 3
Oxford 1
Philadelphia 57
Phoenixville 4
Pittsburgh 48
Pittston 1
Portland 1
Pottstown 1
Reading 5
Rosemont 1
Sayre 1
Schwenkville 1
Secane 1
Sewickley 3
Sharpsville 1
Shenandoah 1
Sproul 1
State College 2
Stoneboro 1
Stroudsburg 1
Sugar Notch 1
Swarthmore 2
Trucksville 1
Union City 1
Uniontown 1
Upper Darby 3
Washington 1
Waynesboro 1
West Chester 2
West Hazleton 1
West Lawn 1
West Newton 1
West Reading 1
Wilkes-Barre 2
Williamsburg 1
Windber 1
Wynnewood 2
Yardley 1
Yeadon 1
York 3

Rhode Island

Barrington 2
Central Falls 1
Edgewood 1
Jamestown 1
Newport 2
North Providence 1
Pawtucket 2
Providence 14
Saylesville 1

South Carolina

Abbeville 1
Beaufort 1
Bluffton 1
Charleston 2
Columbia 6
Darlington 1
Greenville 4
Greenwood 2
Mt. Pleasant 1
Paris Island 2
Richburg 1
Rock Hill 1
Spartanburg 4
Travelers Rest 1

South Dakota

Aberdeen 1
Ft. Meade 2
Hot Springs 4
Hoven 1
Huron 1
Iroquois 1
Lemmon 1
Mission Hills 1
Mobridge 1
Presho 1

Sioux Falls 3
Vermillion 1
Winner 1

Tennessee

Chattanooga 3
Cookeville 1
Copperhill 1
Covington 1
Elizabethton 1
Hendersonville 1
Jefferson City 1
Johnson City 2
Kingsport 1
Knoxville 1
Lawrenceburg 1
Madison College 4
Memphis 17
Minor Hill 1
Nashville 14
Signal Mountain 1

Texas

Abilene 2
Alice 2
Amarillo 2
Anahuac 1
Austin 10
Balmorhea 1
Bandera 1
Baytown 1
Beaumont 1
Brownsville 1
Camp Hood 1
Corpus Christi 2
Crane 1
Dallas 17
Edinburg 1
El Paso 5
Ft. Sam Houston 6
Ft. Worth 5
Galveston 5
Gonzales 5
Houston 16
Jacksonville 1
Jean 1
Kerens 1
Kerrville 1
La Marque 1
Lewisville 1
Lubbock 1
McKinney 1
Muleshoe 1
Ottine 1
Plainview 1
Port Arthur 1
Post 1
Rockwell 1
San Angelo 3
San Antonio 11
San Saba 1
Sheppard AFB 1
Temple 4
Texas City 1
Turkey 1
Tyler 1
Waco 1
Wichita 1
Wichita Falls 1
Ysleta 1

Utah

Kanab 1
Logan 1
Ogden 3
Salt Lake City 15

Vermont

Brattleboro 3
Bristol 2
Burlington 4
Chester Depot 1
Enosburg 1
Fairlee 1
Rutland 1
White River Junction 1

Virginia

Alexandria 3
Arlington 11
Atlee 1
Bedford 1
Berryville 1
Charlottesville 4
Falls Church 2
Farmville 1
Fishersville 5
Ft. Belvoir 2
Ft. Eustis 1
Gloucester 1
Hampton 1
Harrisonburg 1
Hopewell 1
Kecoughtan 1
Lincoln 1
London Bridge 1
Lynchburg 1
Martinsville 1
Newport News 1
Norfolk 1
Norton 1
Piney River 1
Portsmouth 3
Richmond 32
Roanoke 2
Stephens City 1
University 1
White Gate 1
Williamsburg 1
Winchester 2
Wytheville 1

Washington

Aberdeen 1
Bellingham 4
Benge 1
Bothell 1
Bremerton 3
Centralia 1
Chimacum 1
Cleelum 1
College Place 1
Davenport 1
Edmonds 2
Ellensburg 1
Everett 2
Ft. Lewis 2
Lake Stevens 2
Mercer Island 2
Mukilteo 1
Odessa 1
Olypmia 2
Pullman 1
Renton 1
Richland 1
Seattle 49
South Colby 1
Spokane 9
Tacoma 14
Toppenish 1
Urban 1
Vancouver 3
Walla Walla 2
Wenatchee 1
Yakima 3

West Virginia

Amherstdale 1
Charleston 3
Colfax 1
Fairmont 1
Huntington 5
Idamay 1
Marmet 1
Martinsberg 1
Milton 1
Morgantown 3
Mullens 1
Reed 1
Wheeling 1

Wisconsin

Appleton 3
Beaver Dam 1
Beloit 2
Big Bend 1
Cambria 1
Chippewa Falls 2
Delafield 1
Delavan 1
De Pere 1
Eau Claire 8
Fond du Lac 1
Ft. Atkinson 1
Green Bay 8
Hales Corners 1
Hudson 1
Janesville 1
Kaukauna 1
Kenosha 4
La Crosse 3
Lake Geneva 1
Lake Mills 1
Livingston 1
Madison 26
Manitowoc 2
Marathon City 1
Mattoon 1
Menasha 1
Middleton 1
Milwaukee 50
Montreal 1
Mosinee 1
Mukwonago 2
Neenah 1
Neillsville 1
Oconto 2
Oshkosh 1
Park Falls 1

Racine 2
Sheboygan 1
Stoughton 1
Superior 4
Walworth 1
Waterloo 1
Waukesha 3
Wausau 3
Wauwautosa 3
West Bend 2
Wisconsin Dells 1

Wyoming

Casper 1
Cheyenne 4
Laramie 2
Newcastle 1
Rock Springs 1
Sheridan 1

Alaska

Anchorage 1
Cordova 1
Sitka 1
Valdez 1

Canada

Calgary 1
Hamilton 1
Montreal 1
Sussex 1
Winnipeg 1

Canal Zone

Balboa 2
Curundu 1

Foreign

Auckland, N. Z. 1
Cardenas, Cuba 1
Damascus, Syria 1
Guam 1
Jerusalem, Israel 1
London, England 1
Montevideo, Uruguay, S. A. 1
Reykjavik, Iceland 1
San Pedro Sula, Honduras 1
Santiago, Chile, S. A. 3
Shanghai, China 1
Tel Avil, Israel 1

Hawaii Islands

Hilo 1
Honolulu 6

Puerto Rico

Bayamon 1
Fajardo 1
Hato Rey 1
Las Piedras 1
Ponce 2
Rio Piedras 3
San Juan 5
Santurce 5

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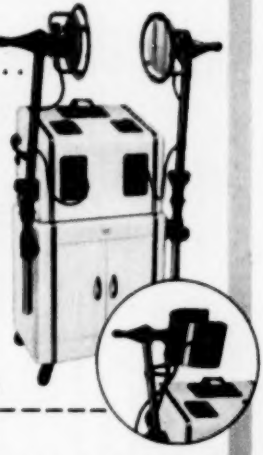

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Childrens Hospital, Los Angeles[1]	S. S. Mathews, M.D. Mrs. Sarah S. Rogers	a-b-d	14 mos.	Sept	14	$200	Cert. or Degree
College of Medical Evangelists, Los Angeles[1]	Fred B. Moor, M.D. R. William Berdan	a-b-c	15 mos.	Sept	16	$300	Cert. or Dipl.
University of Southern California, Los Angeles[1, 10]	Charles L. Lowman, M.D. Miss Charlotte W. Anderson	a-b-e c-d-HS	15 mos. 1-4 yrs.	Sept Sept,Feb	20	$394 $16 per unit[2]	Certificate Cert. & Degree
University of California Hospital, San Francisco[1]	Lucile M. Ising, M.D. Mrs. Margery L. Wagner	d	12 mos.	Sept	16	$220[3]	Cert. or Degree
Stanford University, Stanford University, Calif.[1]	W. H. Northway, M.D. Miss Lucille Daniels	a-b-d	12 mos.	Varies	15	$520	Cert. or Degree
University of Colorado Medical Center, Denver[1]	Harold Dunken, M.D. Miss Mary Lawrence	a-b-d	12 mos.	Sept	12	$200[4]	Cert. or Degree
Northwestern University Medical School, Chicago	Emil D. W. Hauser, M.D. Miss Gertrude Heard	a-b-d	12 mos.	Oct	10	$450	Certificate
State University of Iowa Medical School, Iowa City[1]	W. D. Paul, M.D. Mrs. Olive Farr	e	12 mos.	Sept	15	$200	Certificate
University of Kansas School of Medicine, Kansas City[1]	Donald L. Rose, M.D. Mrs. Ruth G. Monteith	a-b-d	12 mos.	Feb,Sept	15	$ 80[5]	Cert. or Degree
Bouvé-Boston School of Physical Education, Medford, Mass.	Howard Moore, M.D. Miss Constance Greene	H.S.	4 yrs.	Sept	15	$550	Dipl. & Degree
Simmons College, Boston	W. T. Green, M.D. Miss Janet B. Merrill	H.S.-e	11½-4½ yrs.	Sept	25	$550	Dipl. or Degree
Boston University College of Physical Education for Women, Sargent College, Cambridge, Mass.	Kenneth Christophe, M.D. Miss Adelaide McGarrett	H.S.-e-d	1-4 yrs.	Sept	30	$450	Cert. or Degree
University of Minnesota, Minneapolis[1]	M. E. Knapp, M.D. Miss Ruby M. Green	H.S.	4 yrs.	Sept	16	$180[6]	Degree
Mayo Clinic, Rochester, Minn.[1]	Earl C. Elkins, M.D. Miss Helen Belknap	a-e	12 mos.	Sept	30	None	Certificate
Washington Univ. School of Medicine[1]	Sedgwick Mead, M.D. Miss Beatrice Schulz	c	2 yrs.	Sept	12	$775[10]	Degree
St. Louis University School of Nursing, St. Louis[1]	A. J. Kotkis, M.D. Sister Mary Imelda	H.S.	4 yrs.	Jan,Sept	10	$300	Degree
Albany Hospital, Albany, N. Y.	J. W. Ghormley, M.D. Miss Catherine Graham	a-b-d	12 mos.	Sept	6	$250	Certificate
Columbia University College of Physicians and Surgeons, New York City[1]	William B. Snow, M.D. Miss Flos Pinkerton	a-c-e	1-2 yrs.	Sept	50	$710	Cert. or Degree
New York University School of Education, New York City[1]	George G. Deaver, M.D. Miss Elizabeth Addoms	a[7]-b-d	12 mos.	Sept	40	$400	Cert. & Degree
Duke Hospital, Durham, N. C.[1]	Lenox D. Baker, M.D. Miss Helen Kaiser	a-b-d	15 mos.	Oct	15	$350	Certificate
D. T. Watson School of Physiatrics, Leetsdale, Pa.[1]	Jessie Wright, M.D. Miss Kathryn Kelley	a-b-d	12 mos.	Oct	30	$300	Diploma
Graduate Hospital of the University of Pennsylvania, Philadelphia[1]	George M. Piersol, M.D. Miss Dorothy Baethke	a-b-d	12 mos.	Sept	20	$400	Certificate
University of Texas School of Medicine, Galveston[1]	G. W. N. Eggers, M.D. Miss Ruby Decker	b-d	12 mos.	Jan	8	$163[8]	Certificate
Hermann Hospital, Houston[1]	Oscar O. Selke, Jr., M.D. Mary Elizabeth Kolb	a-b-d	12 mos.	Oct	12	$200	Cert. or Degree
Baruch Center of Physical Medicine of the Medical College of Virginia, in affiliation with Richmond Professional Institute, Richmond[1]	Walter J. Lee, M.D. Miss Susanne Hirt	H.S.-a-b-c-d-e	1-4 yrs.	Sept	54	$275[9]	Dipl. or Degree
University of Wisconsin Medical School, Madison	Harry Bouman, M.D. Miss Margaret A. Kohli	a-b-c H.S.	12 mos. 4 yrs.	Feb,Sept Sept	20 30	$120[5]yr $120[5]yr	Certificate Cert. & Degree
Medical Department — U. S. Army — Medical Field Service School, Brooke Army Medical Center, San Antonio, Texas, and Fitzsimmons General Hospital, Denver, Colorado or Walter Reed General Hospital, Army Medical Center, Washington, D. C.	James E. Tate, Lt. Col., M.C. Agnes P. Snyder, Major, WMSC Harold B. Luscombe, Col., M.C. Olena M. Cole, Capt., WMSC John H. Kuitert, Colonel, M.C. Barbara Robertson, Capt., WMSC	h Completion MFSS Completion MFSS	12[13] 12[13] 12[13]	Nov. June June	20 10 10	None None None	See Below Certificate Certificate
Permanente School of Physical Therapy, Oakland, Calif.	O. Leonard Huddleston, M.D. Miss Dorothy Hoag	a-b-d	12 mos.	July	20	$200	Certificate
Cleveland Clinic Hospital, Cleveland, Ohio	Shelby G. Gamble, M.D. Miss Anna Wetterhuus	a-b-d	12 mos.	July	12	$200	Diploma

** Courses are so arranged that any of the entrance requirements will qualify students for training. a — Graduation from accredited school of nursing; b — Graduation from accredited school of physical education; c — Two years of college with science courses; d — Three years of college with science courses; e — Four years of college with science courses. H.S. — High school graduation. h — Baccalaureate degree with major in physical education or the biological sciences.

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1. Male students are admitted.
2. R.N. plus one year college.
3. Nonresidents charged additional fee.
4. 12 months includes training at the Medical Field Service School and Fitzsimons or Walter Reed General Hospitals.
5. Nonresidents charged additional fee.
6. Students may transfer into the degree course at the Freshman, Sophomore, Junior or Senior Level. All are held responsible for requirements as listed in curriculum outline. This refers to professional as well as nonprofessional courses.
7. First year—$450. Second year—$325.
8. Nonresidents charged additional fee.
9. First year—$450. Second year—$325.
10. Students may transfer into the degree course at the Freshman, Sophomore, Junior or Senior Level. All are held responsible for requirements as listed in curriculum outline. This refers to professional as well as nonprofessional courses.
13. 12 months includes training at the Medical Field Service School and Fitzsimons or Walter Reed General Hospitals.

APPROVED SCHOOLS FOR OCCUPATIONAL THERAPISTS

Council on Medical Education and Hospitals of the American Medical Association

NOTE: The duration of the course is expressed in academic years.

Name and Location of School	College Affiliation	Duration of Course	Classes Start	Entrance Requirements	Tuition per Year	Certificate, Diploma	Graduates in 1947
University of Southern California, 923½ 35th Place, Los Angeles	University of Southern California	2 yrs. 5 yrs.	FebSept FebSept	Degree High sch.	$420 $450	Certificate Cert.&B.S.	22
Mills College, Oakland, Calif.	Mills College	3 yrs.	FebSept	Degree	$200 $550	Certificate	—
San Jose State College, San Jose, Calif.	San Jose State College	1½ yrs. 3¼ yrs.	Varies Varies	Degree High sch.	$ 21 $ 21	Certificate Degree	10
University of Illinois College of Medicine, 1853 W. Polk St., Chicago	University of Illinois	5 yrs.	Feb	High sch.	$152	B.S.	14
University of Iowa, Iowa City, Iowa	State University of Iowa, College of Medicine	5 yrs.	.....	High sch.	$ 85	Cert.&Deg	
University of Kansas, Lawrence	University of Kansas	2 yrs. 4 yrs.	FebSept FebSept	Degree High sch.	$131 $131	Certificate B.S.	10
Boston School of Occupational Therapy, 7 Harcourt St., Boston	Tufts College	2 yrs. 5 yrs.	Sept Sept	Degree High sch.	$500 $450	Diploma B.S.	13
Wayne University, 4841 Cass, Detroit, Mich.	Wayne University, College of Med., Coll. of Liberal Arts, Coll. of Education	5 yrs.	.....	High sch.	.....	.....	
Kalamazoo School of Occupational Therapy, Western Michigan College of Education, Kalamazoo	Western Michigan College of Education	1½ yrs. 4 yrs.	FebSept FebSept	Degree 1 yr. coll.	$127 $127	Diploma Degree	20
Michigan State Normal College, Ypsilanti	University of Michigan	5 yrs.	Varies	High sch.	$118	Cert.&Deg.	8
University of Minnesota, Church Street, Minneapolis	University of Minnesota	4 yrs.	.....	High sch.	$360	B.S.	
College of St. Catherine, St. Paul, Minn.	The College of St. Catherine	3½ yrs.	Varies	1 yr. coll.	$210	Degree	4
Washington University School of Medicine, St. Louis	Washington University	3 yrs.	Sept	2 yrs. coll.	$400	Degree	10
University of New Hampshire, Durham	Univ. of New Hampshire	5 yrs.	Sept	High sch.	$160	Cert.&Deg.	6
Columbia University College of Physicians and Surgeons, 630 W. 168th St., New York City	Columbia University	1½ yrs. 2½ yrs.	Sept Sept	Degree 2 yrs. coll.	$450 $450	Certificate Degree	28
New York University School of Education, 100 Washington Sq. E., New York City	New York University	4½ yrs.	FebSept	High sch.	$500	Cert.&Deg.	20
Ohio State University, Columbus	Ohio State University	3 yrs.	Quarterly	High sch.	$105	Degree	21
Philadelphia School of Occupational Therapy, 419 S. 19th St., Philadelphia	University of Pennsylvania	1½ yrs. 3 yrs.	Sept Sept	Degree 1 yr. coll. High sch.	$500 $500 $600	Diploma Diploma	35
Texas State College for Women, Denton, Tex.	Texas State College for Women	5 yrs.	FebSept	High sch.	$150	Degree	13
Richmond Professional Institute, 901 W. Franklin St., Richmond, Va.	Medical College of Virginia	1½ yrs. 3 yrs.	Sept Sept	Degree 1 yr. coll.	$200 $200	Certificate Certificate	20
College of Puget Sound, Tacoma, Wash.	College of Puget Sound	3 yrs. 5 yrs.	FebSept FebSept	Degree High sch.	$350 $300	Certificate Cert.&Deg.	
University of Wisconsin, Madison	University of Wisconsin	4 yrs.	FebSept	High sch.	$320	Cert.&Deg.	8
Milwaukee-Downer College, Dept. of Occupational Therapy, 2512 E. Hartford, Milwaukee	Milwaukee-Downer College	2½ yrs. 4 yrs.	Sept Sept	1 yr. coll. High sch.	$300 $300	Diploma Dipl.&Deg.	22
Mount Mary College, 2900 Menomonee River Dr., Milwaukee		Varies	Sept	Degree	$335	Certificate	15
University of Toronto, Dept. of University Extension, Toronto, Ont., Canada	University of Toronto	5 yrs. 3 yrs.	Sept Sept	High sch. 1 yr. coll.	$260 $222	B.S.Deg. Diploma	110
Colorado Agricultural and Mechanical College, Fort Collins, Colorado		5 yrs.	Sept	High sch.	.....	B.S.	

PHYSICAL MEDICINE **

The following services are approved by the Council on Medical Education and Hospitals of the American Medical Association and the American Board of Physical Medicine and Rehabilitation. Residencies in this specialty have been approved without specifying the number of years for which they are accredited. The Board will give appropriate credit for training in these hospitals on an individual basis.

Hospitals, 42 Assistant Residencies and Residencies, 55

Name of Hospital	Location	Chief of Service	Inpatients Treated	Number of Treatments	Asst. Res. & Residencies Offered §	Beginning of Service (1950)	Beginning Stipend (Month)
United States Army							
Letterman General Hospital★	San Francisco	A. E. White	21,861	185,112	2	1/1, 7/1	n
†Fitzsimons General Hospital★	Denver	H. B. Luscombe	21,090	281,585	4		n
Army Medical Center★	Washington, D. C.	E. M. Smith	8,676	134,137	6	7/1	n
Veterans Administration							
†Veterans Admin. Hospital ¶	Ft. Logan, Colo.	F. J. Fricke	4,610	58,879	1		n
Veterans Admin. Hospital	Chamblee, Ga.	G. D. Williams	4,923	39,181	1	7/1	n
Veterans Admin. Hospital	Hines, Ill.	L. B. Newman	20,052	472,950	3	1/1, 7/1	n
Veterans Admin. Hospital	New Orleans	S. Winokur	1,107	49,815	1	7/1	n
Veterans Admin. Hospital †	Framingham, Mass.	F. Friedland	9,000	24,000	2	7/1	n
Veterans Admin. Hospital †	Jefferson Bks., Mo.	S. Mead	4,046	53,920	2	7/1	n
†Veterans Admin. Hospital †	New York City	K. Harpuder	12,513	279,817	3	1/1, 7/1	n
Veterans Admin. Hospital †	Cleveland	H. T. Zankel	2,452	105,000	2	7/1	n
†Veterans Admin. Hospital	Aspinwall, Pa.	S. Machover	1,993	62,792	1	7/1	n
†Veterans Admin. Hospital	Portland, Ore.	E. W. Fowlks	4,395	96,766	1	1/1, 7/1	n
Residency							
Los Angeles County Hospital★†	Los Angeles	O. L. Huddleston		133,694	1	Varies	$165.00
White Memorial Hospital★	Los Angeles	F. B. Moor	33,606				120.00
Stanford University Hospitals★†	San Francisco	W. H. Northway		6,833		7/1	50.00
University of Colorado Medical Center							
Colorado General Hospital★†	Denver	H. L. Dinken	2,322	25,088	1	7/1	75.00
†Emory University Hospital★	Emory Univ., Ga.	R. L. Bennett	9,848	20,266	1	7/1	50.00
†Georgia Warm Springs Foundation	Warm Springs, Ga.		859	1,108	2		
Cook County Hospital★†	Chicago	D. Kobak	3,357	23,282		1/1, 7/1	
Michael Reese Hospital★†	Chicago	C. O. Molander	1,607	19,443	1	Varies	25.00
Northwestern University Medical School	Chicago		13,284	34,813			
University of Kansas Medical Center★	Kansas City, Kan.	D. L. Rose	11,684	31,838	1	7/1	100.00
†Massachusetts General Hospital★	Boston						
University of Minnesota Hospitals★†	Minneapolis	M. Knapp	15,391	21,885	4		105.00
Mayo Foundation	Rochester, Minn.	F. H. Krusen			9	Varies	92.50
Barnes Hospitals★	St. Louis		820	10,951		7/1	25.00
†Bellevue Hospital, Div. III—							
New York University★	New York City						
Goldwater Memorial Hospital★†	New York City		2,799	124,357			
†Hospital for Joint Diseases★†	New York City	J. Weiss	76,070	93,036	1	7/1	40.00
Hospital for Special Surgery	New York City	K. G. Hansson		41,111			
Montefiore Hosp., for Chronic Diseases★†	New York City	K. Harpuder					
Mount Sinai Hospital★	New York City	W. Bierman				7/1	50.00
New York City Hospital★†	New York City	F. K. Safford, Jr.	955	26,418			
†Presbyterian Hospital ★†	New York City	W. B. Snow	70,405	191,021	2	1/1	41.66
St. Luke's Hospital★	New York City	R. Muller	1,202	126,904	1	7/1	50.00
†Rehabilitation Hospital †	W. Haverstraw, N.Y.	M. Hoberman	322	291,115	1		200.00
Cleveland Clinic Hospital †	Cleveland	S. G. Gamble	17,845	17,884	1	7/1	135.00
Hospital of the Univ. of Pennsylvania★†	Philadelphia	G. M. Piersol	1,396	15,575	1	Varies	100.00
Philadelphia General Hospital★†	Philadelphia		3,073	21,769			
Medical College of Virginia, Hosp. Div. ★†	Richmond, Va.	F. A. Hellebrandt	3,787	24,009			
State of Wisconsin General Hospital★†	Madison, Wis.	H. D. Bouman	3,783	45,840			

The star (★ indicates hospitals approved for training interns.
The dagger (†) indicates temporary approval.
† Residencies open to women.
§ Includes Fellowships.
n Salary established by government pay tables.
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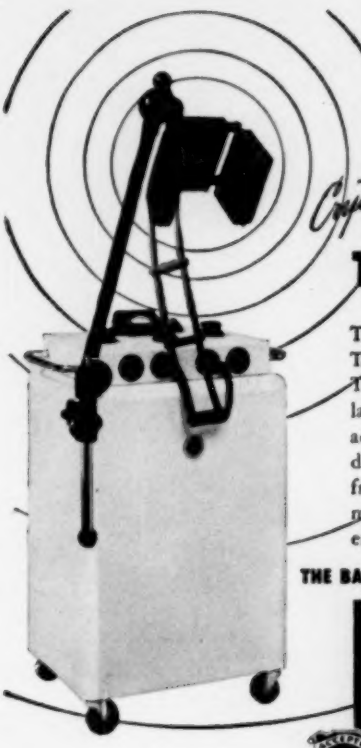

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